

# CAIS STANDARD MANUAL

## SYSTEM NO. 7 BUILDING PLUMBING

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**07 BUILDING PLUMBING**

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## 07 BUILDING PLUMBING

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### ABSTRACT

#### GENERAL ORGANIZATION

At this installation the list of facilities to be surveyed will be addressed on the basis of 32 unique systems that form the CAIS Engineering Deficiency Standards and Inspection Methods document. Each system deals with a specific technical aspect of the facility to be surveyed. Within each system a further breakdown is made to subsystems, each having a specific list of components. Specific observations of the listed defects are provided so as to allow the entry of observed quantification data. A DOD CAIS manual is provided for each of the 32 systems with an internal organization as outlined below:

#### INSPECTOR'S GUIDE

- I. General
  - A. Level I Inspection Method Description
  - B. Level II Inspection Method Description
  - C. Level III Inspection Method Description
- II. General Inspection
  - A. Process. This section describes the process of the inspection activity.
  - B. Location. This section describes the procedure for locating the inspection units in the facility or infrastructure on this installation.
- III. Inspector Qualifications

This section notes the minimum qualifications for the person or persons performing the survey.
- IV. Inspection Unit

This section describes how the IU (Inspection Unit) is determined for the particular component being surveyed.
- V. Unit Costs

This section notes the nature of repair costs for this system.
- VI. Standard Safety Requirements

This section lists safety procedures and equipment required to implement a safe environment for the conduct of this survey.
- VII. Standard Tools

This section lists a set of standard tools required for the general conduct of this survey.
- VIII. Special Tools and Equipment Requirements

This section refers to special tools or equipment requirements endemic to the nature of the system being surveyed.

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### IX. Level II Inspection Method Keys

This section explains the use of keys as they relate to Level II Guide Sheets.

### X. Level III Inspection Method Keys

This section explains the use of keys as they relate to Level III Guide Sheets.

### XI. Replacement Cost

This section describes the nature and location of replacement cost data.

### XII. Appendices

Appendix A. Provides a listing and definition of all abbreviations used both in the Standards and in the data base.

Appendix B. Provides a glossary of terms with their definitions as used in the Standard.

Appendix C. This section contains a listing of the average life cycle durations for each assembly\* in the Standard.

- \* Assembly is a term describing the level at which replacement rather than repair occurs. This can be at the subsystem or component designation, depending on the system being surveyed.

## SYSTEM TREE

The System Tree is a graphical representation of the Work Breakdown Structure, showing system, subsystem and component relationships for the Building Plumbing System.

## INSPECTION METHODS

### Description

Describes the nature of what is to be condition surveyed.

### Special Tool and Equipment Requirements

Lists any special tools required for this specific subsystem.

### Special Safety Requirements

This section outlines any special safety measures or equipment required for this specific subsystem so as to maintain a safe environment and process in the conduct of the condition survey.

### Component List

All components to be surveyed under this subsystem are listed here.

### Related Subsystems

All other subsystems that have a survey relationship to this subsystem are listed here to help coordinate a complete and thorough condition assessment survey.



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### Standard Inspection Procedure

This statement indicates the various levels of survey effort required for this subsystem.

### Components

The previously listed components of this subsystem are described with a survey procedure recommended on a component by component basis. For each component there is a listing of defects with each defect broken down into observations describing the nature and severity of the defective condition observed. The surveyor enters a quantification value for each defect/observation encountered in the field CAIS device (DCD) to record the result of his survey.

### References

This page lists the reference sources from which the foregoing subsystem data was developed.

### Guide Sheet Control Number

This section lists the key numbers that tie the written Level II and Level III guide sheets to specific components in this subsystem.

### Level II and Level III Inspection Method Guide Sheets

This section contains the detailed descriptions of the Level II and III survey and inspection procedures for this subsystem.

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### INSPECTOR'S GUIDE

#### I. GENERAL

##### A. Level I Inspection Method

The Level I Inspection Method of building plumbing systems consists of a thorough inspection of each subsystem and component as described in the Work Breakdown Structure. Only readily accessible components need to be addressed during a Level I inspection. The survey activity is designed to be performed by a single surveyor.

##### B. Level II Inspection Method

Level II inspections are triggered by defect/observations noted at the Level I inspection or in some cases, are required to conduct a meaningful survey of the component being inspected. The Building Plumbing System requires very few Level II inspections, since most defects are readily apparent from a Level I. For instance, the investigation of grinding noises in a circulating/lift pump may dictate that a Level II inspection be performed. Level II inspections are referenced by defect/observations through a "Level II key", which denotes a specific Guide Sheet that describes the Level II inspection activity.

##### C. Level III Inspection Method

The Level III inspection is triggered by defect/observations occurring in the Level I and II inspections. The Level III inspection can also occur as a result of time based scheduling, antidotal experience, or component age compared to its life cycle. The Level III inspection is referenced through a Level III key which in turn, denotes a specific Guide Sheet describing the Level III inspection process and requirements. Level III inspections produce a detailed, written engineering assessment of the deficiency along with an estimated cost of correction, and are performed at the option of the Facility Manager.

#### II. GENERAL INSPECTION

##### A. Process

Surveys are normally conducted at the component level. Figure 07-A provides the breakdown from system through component for the Building Plumbing System. The surveyor will work through the Work Breakdown Structure (WBS) to conduct the inspection. At the component level the surveyor will be provided a list of defects, each of which is described further in detail as observations. These observations are described to various levels of severity as they relate to the effect of the life of the system. The quantification of each deficiency is identified by the surveyor using the associated unit of measure. Once an observation is populated with a deficient quantity, the inspector will be requested to provide information on the component type and location. The installation date or age of the component may be preloaded into the WBS for each asset from the Real Property Inventory List or site specific information.

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If necessary, age data can be overridden by the surveyor, Site CAIS personnel, or the Facility Manager.

### B. Location

Level I and II inspections will be located by the surveyor through a discrete entry in the Field CAIS. Building floor plans or sketches are required to ensure a complete inspection of all areas and to assist in the location of IU's. The inspection team members must use the recommended room numbering schemes for the installation. The installation may have rooms physically identified by a numbering system or identified on floor plans. If both exist and are different, the Facility Manager will develop guidance on which numbering system takes precedence. Where numbering systems do not exist or are not complete in identifying each space, specific guidance for the inspector to annotate areas in a consistent manner should be developed by the Facility Manager and implemented in the installations CAS process. In all cases, plans and maps shall be orientated with the top of each sheet being the north direction, so as to allow directional location and description. In the case where no other means of location exist the inspector shall enter a brief (65 character) description of location. Locations must be accurate to insure future repeatability and consistent results.

### III. INSPECTOR QUALIFICATIONS

The minimum inspector qualification for the Building Plumbing System requires a five year journeyman. All of the condition survey requirements for this system can be accomplished at the Level I inspection by a single inspector, however, safety and other considerations may require that inspectors work in teams. Inspectors will be specifically trained in the CAS system and its usage and will be CAS certified in the "Mechanical" discipline.

### IV. INSPECTION UNIT (IU)

The Inspection Unit (IU) is normally defined at the component level for this system. The varied configurations of the components that exist in the Building Plumbing System require that they be evaluated differently when defining the IU. Therefore, the measurement technique requires some consideration. If the inspector finds multiple defects that occur on the same IU, the inspector will quantify the observation that is considered most severe and identify the remaining quantity under the less severe observation for the discrete component. The IU's for the most common components would be defined as follows:

- Piping, fittings and valves - The IU is defined as the linear footage of the affected section of pipe containing the defect in a particular location (to include the fittings and valves along that section). For example, five sections of 2" DIA pipe extend the length of a 20' wall within a mechanical room. If the inspector were to observe 2 LF of bent pipe on one 20 LF section, the IU would be 20 LF, not the total amount of 2" DIA pipe in the room of 100 LF.

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- Valve, Sump, etc. - The IU for singularly defined items such as these are defined as each.

### V. UNIT COSTS

The unit costs that are applied to the quantities recorded for each observation are contained within the Site CAIS as repair cost.

### VI. STANDARD SAFETY REQUIREMENTS

The Master Safety Plan will be followed at all times during the condition survey.

Inspector may utilize the following protective gear:

- Hard hat - to be worn during all surveys
- Safety glasses - to be worn during all surveys
- Safety shoes - to be worn during all surveys
- Coveralls - to be worn as necessary
- Gloves - to be worn as necessary
- Ear plugs - to be worn in designated areas
- Knee pads - to be worn when crawling is required
- Rain suit - to be worn as necessary

### VII. STANDARD TOOLS

Employee Identification Card - to be worn or carried during all survey activities  
Data Collection Device (DCD)  
Battery pack for DCD  
Flashlight  
Tape measure - 20' (or other supplemental measuring devices)  
Screwdrivers - Phillips and straight slot  
Pliers  
Pocket knife or ice pick

### VIII. SPECIAL TOOLS AND EQUIPMENT REQUIREMENTS

At the subsystem level, the deficiency standard has identified special tools and equipment required for the standard inspection of the associated components, which exceed the standard tools identified for the system. Level III Inspection Method Guide Sheets will address additional tools and equipment requirements that are specific to that particular advanced method of inspection.

Facility Managers should review these sections in order to determine any special tool requirements for subsystems they are to inspect/survey.

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**IX. LEVEL II INSPECTION METHOD KEYS**

Certain observations will reference a Level II Inspection Method. The Facility Manager will be able to identify deficiencies where a Level II inspection is flagged. The Level II key at the observation level will refer to a specific guide sheet.

All Level II Guide Sheets are located at the end of each Subsystem section. A Guide Sheet Reference page precedes Level II and Level III Guide Sheets.

**X. LEVEL III INSPECTION METHOD KEYS**

Certain observations will trigger a Level III inspection. The Facility Manager will be able to identify deficiencies where a Level III inspection is flagged. The Level III Key at the observation level will refer to a specific guide sheet. These guide sheets may refer the Facility Manager to a more sophisticated and costly test method.

All Level III Guide Sheets are located at the end of each Subsystem section. A Guide Sheet Reference page precedes Level II and Level III Guide Sheets.

The following is a list of the Level III Inspection Methods that are not flagged at the observation level in the DOD CAS Manual, but are available to the Facility Manager:

1. Ultrasonic thickness testing of piping, fittings and valves.

There exists break points where it is more cost effective to replace equipment or components rather than expend the cost to perform a Level III inspection. It is recommended that the Facility Manager review the base replacement records for equipment and components. A sizing guide can be developed to establish the most cost effective approach of either initiating a Level III inspection or replacement of equipment or components.

It is recommended that the sizes of equipment listed below be the criteria for the lower limit for which a Level III inspection is considered.

Pumps	40 GPM
Motors	60 HP
Air Compressors	100 CFM
Vacuum Pumps	50 CFM

The Facility Manager is not limited by these sizing guides, he can authorize any Level III inspection he feels necessary for specialized equipment or components.

**XI. REPLACEMENT COST**

A replacement cost for each subsystem type will be contained within the cost estimating system in the Site CAIS.

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**XII. APPENDICES****Appendix A - Abbreviations**

A summary and definition of all abbreviations used in this system are contained in Appendix A which is located at the end of Building Plumbing.

**Appendix B - Glossary**

A glossary of terms used in this system are contained in Appendix B which is located at the end of Building Plumbing.

**Appendix C - Life Cycles**

A listing of the average life cycle duration for each assembly\* in the Standard.

**Note - Facility Manager's Guide**

The following are included in the Facility Manager's Guide:

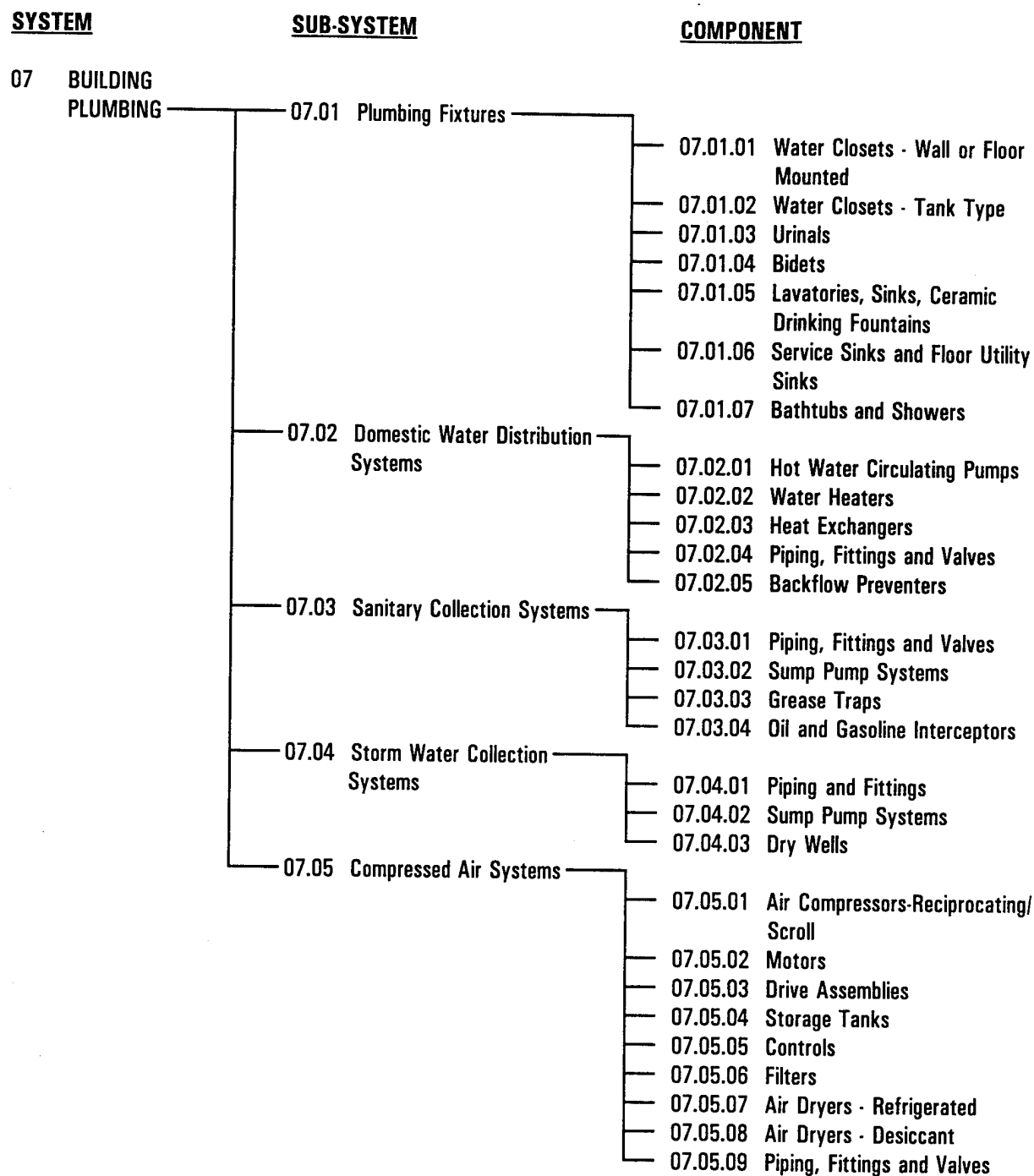
A table showing the required manhours to perform the standard inspection for this facility listed by Cat Code (three digit).

A listing of all Level III inspections with their estimated cost and time to perform. This list will include frequency of inspections for time driven Level III's.

\* Assembly is a term describing the level at which replacement rather than repair occurs. This can be at the subsystem or component designation, depending on the system being surveyed.

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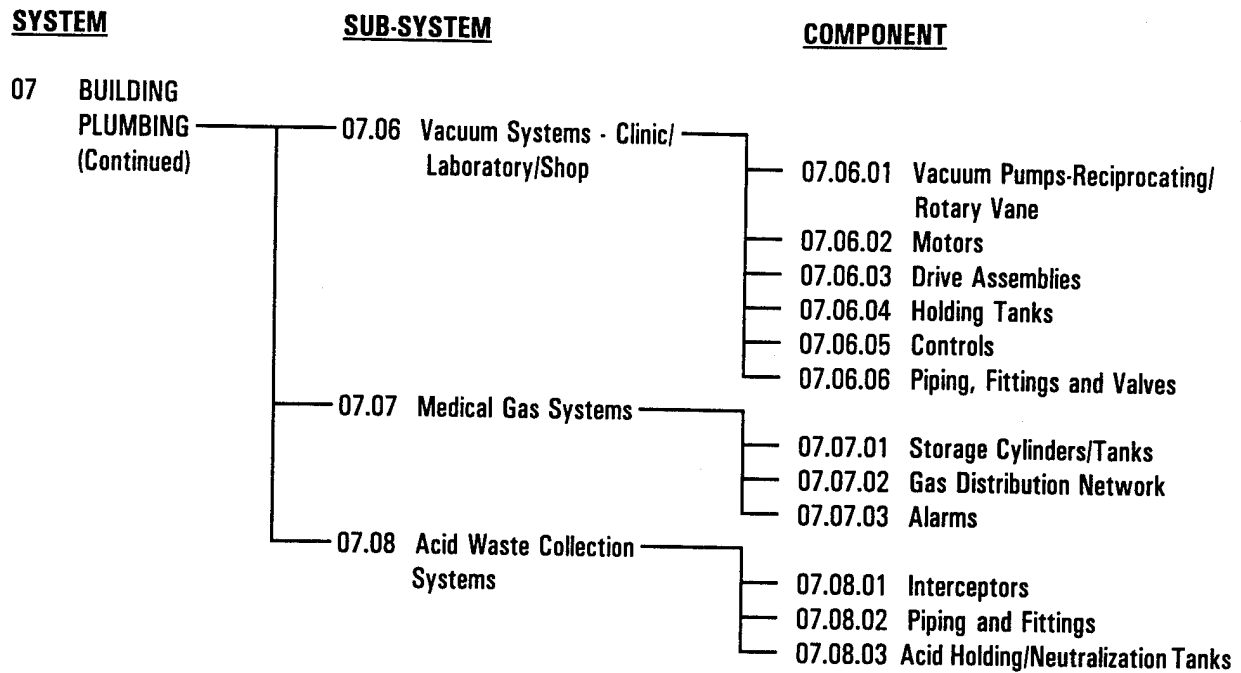
**Figure 07-A. WORK BREAKDOWN STRUCTURE**



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**Figure 07-A. WORK BREAKDOWN STRUCTURE (Continued)**



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## 07.01 PLUMBING FIXTURES

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### DESCRIPTION

Plumbing Fixtures is a subsystem of the Building Plumbing system. The plumbing fixtures are approved type installed receptacles, devices or appliances which are supplied with water or receive liquid or liquid borne wastes, and discharge such wastes into the drainage system to which they may be directly or indirectly connected.

### SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

No special tools are required for the inspection of the Plumbing Fixtures, beyond the requirements listed in the Standard Tools Section.

### SPECIAL SAFETY REQUIREMENTS

No special safety requirements are needed for the inspection of the Plumbing Fixtures, beyond the requirements listed in the Master Safety Plan and System Safety Section.

### COMPONENT LIST

- ◆ 07.01.01 WATER CLOSETS - WALL OR FLOOR MOUNTED
- ◆ 07.01.02 WATER CLOSETS - TANK TYPE
- ◆ 07.01.03 URINALS
- ◆ 07.01.04 BIDETS
- ◆ 07.01.05 LAVATORIES, SINKS, CERAMIC DRINKING FOUNTAINS
- ◆ 07.01.06 SERVICE SINKS AND FLOOR UTILITY SINKS
- ◆ 07.01.07 BATHTUBS AND SHOWERS

### RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities.

- 07.02 DOMESTIC WATER DISTRIBUTION SYSTEMS
- 07.03 SANITARY COLLECTION SYSTEMS

## 07.01 PLUMBING FIXTURES

### STANDARD INSPECTION PROCEDURE

This subsystem requires a Level I inspection as part of the basic inspection process. Associated defects and observations, for each major component, are listed in the Field CAIS. All flush valves and faucets shall be exercised to check the operation of the fixtures.

### COMPONENTS

#### ♦ 07.01.01 WATER CLOSETS - WALL AND FLOOR MOUNTED

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Leaking/damaged.</b>			
Observation:			
a. Leaking flush valve.	EA		
*** {Severity M}			
b. Leaking water closet drain seal.	EA		
*** {Severity H}			
c. Cracked bowl.	EA		
*** {Severity H}			
<b>* Malfunctioning drain.</b>			
Observation:			
a. Water closet drains slowly.	EA		
*** {Severity M}			
b. Clogged drain.	EA		
*** {Severity H}			
<b>* Loose mounting.</b>			
Observation:			
a. Missing/deteriorated caulking.	EA		
*** {Severity F}			
b. Loose mounting bolts/hardware.	EA		
*** {Severity M}			
c. Missing mounting bolts/hardware.	EA		
*** {Severity H}			

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**07.01 PLUMBING FIXTURES**

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**COMPONENTS (Continued)**

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**◆ 07.01.01 WATER CLOSETS - WALL AND FLOOR MOUNTED (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Damaged toilet seat.</b>			
Observation:			
a. Broken/missing toilet seat.	EA		
*** {Severity F}			
b. Loose toilet seat.	EA		
*** {Severity F}			
c. Wrong size toilet seat.	EA		
*** {Severity F}			
<b>* Corrosion.</b>			
Observation:			
a. Etched or pitted surface of flush valve.	EA		
*** {Severity M}			
b. Etched or pitted surface of porcelain bowl.	EA		
*** {Severity M}			

## 07.01 PLUMBING FIXTURES

### COMPONENTS (Continued)

#### ◆ 07.01.02 WATER CLOSETS - TANK TYPE

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Leaking/damaged bowl.</b>			
Observation:			
a. Leaking water closet drain seal.	EA		
*** {Severity H}			
b. Cracked bowl.	EA		
*** {Severity H}			
<b>* Damaged tank lid.</b>			
Observation:			
a. Cracked tank lid.	EA		
*** {Severity L}			
b. Missing tank lid.	EA		
*** {Severity M}			
c. Loose or damaged flush handle.	EA		
*** {Severity M}			
d. Leaking tank gasket.	EA		
*** {Severity M}			
e. Cracked tank.	EA		
*** {Severity H}			
<b>* Malfunctioning drain.</b>			
Observation:			
a. Water closet drains slowly.	EA		
*** {Severity M}			
b. Clogged drain.	EA		
*** {Severity H}			
<b>* Water runs continuously.</b>			
Observation:			
a. Sticking flush arm.	EA		
*** {Severity L}			
b. Malfunctioning flush valve.	EA		
*** {Severity M}			

## 07.01 PLUMBING FIXTURES

### COMPONENTS (Continued)

#### ♦ 07.01.02 WATER CLOSETS - TANK TYPE (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Loose mounting.</b>			
Observation:			
a. Loose mounting bolts/hardware.	EA		
*** {Severity M}			
b. Missing mounting bolts/hardware.	EA		
*** {Severity H}			
<b>* Damaged toilet seat.</b>			
Observation:			
a. Broken/missing toilet seat.	EA		
*** {Severity F}			
b. Wrong size toilet seat.	EA		
*** {Severity F}			
c. Broken/missing toilet seat.	EA		
*** {Severity F}			
<b>* Tank fills slowly.</b>			
Observation:			
a. Inadequate water supply.	EA		
*** {Severity F}			
b. Malfunctioning flush valve.	EA		
*** {Severity M}			
<b>* Corrosion.</b>			
Observation:			
a. Etched or pitted surface of flush valve.	EA		
*** {Severity M}			
b. Etched or pitted surface of porcelain bowl.	EA		
*** {Severity M}			

## 07.01 PLUMBING FIXTURES

### COMPONENTS (Continued)

#### ♦ 07.01.03 URINALS

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Leaking/damaged.</b>			
Observation:			
a. Leaking flush valve.	EA		
*** {Severity M}			
b. Cracked urinal.	EA		
*** {Severity H}			
c. Malfunctioning flush valve.	EA		
*** {Severity H}			
d. Leaking urinal drain piping or seal.	EA		
*** {Severity H}			
<b>* Loose mounting.</b>			
Observation:			
a. Deteriorated/missing caulking.	EA		
*** {Severity F}			
b. Loose mounting bolts/hardware.	EA		
*** {Severity M}			
c. Missing mounting bolts/hardware.	EA		
*** {Severity H}			
<b>* Malfunctioning drain.</b>			
Observation:			
a. Urinal drains slowly.	EA		
*** {Severity L}			
b. Clogged drain.	EA		
*** {Severity H}			
<b>* Loose/missing drain grate.</b>			
Observation:			
a. Loose drain grate.	EA		
*** {Severity L}			
b. Missing/damaged drain grate.	EA		
*** {Severity M}			

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**07.01 PLUMBING FIXTURES**

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**COMPONENTS (Continued)**

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**♦ 07.01.03 URINALS (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Corrosion.</b>			
Observation:			
a. Etched or pitted flush valve surface.	EA		
*** {Severity M}			
b. Etched or pitted porcelain surface.	EA		
*** {Severity M}			
c. Etched or pitted drain piping.	EA		
*** {Severity M}			

## 07.01 PLUMBING FIXTURES

### COMPONENTS (Continued)

#### ◆ 07.01.04 BIDETS

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Leaking/damaged.</b>			
Observation:			
a. Dripping faucets.	EA		
*** {Severity M}			
b. Leaking bidet drain seal	EA		
*** {Severity H}			
c. Cracked bidet.	EA		
*** {Severity H}			
d. Malfunctioning faucets.	EA		
*** {Severity H}			
<b>* Loose mounting.</b>			
Observation:			
a. Loose mounting bolts/hardware.	EA		
*** {Severity M}			
b. Missing mounting bolts/hardware.	EA		
*** {Severity H}			
<b>* Malfunctioning drain.</b>			
Observation:			
a. Bidet drains slowly.	EA		
*** {Severity M}			
b. Clogged drain.	EA		
*** {Severity H}			
<b>* Corrosion.</b>			
Observation:			
a. Etched or pitted surface of faucet.	EA		
*** {Severity L}			
b. Etched or pitted surface of porcelain bowl.	EA		
*** {Severity M}			



## 07.01 PLUMBING FIXTURES

### COMPONENTS (Continued)

#### ♦ 07.01.05 LAVATORIES, SINKS, CERAMIC DRINKING FOUNTAINS

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Leaking/damaged.</b>			
Observation:			
a. Dripping faucets.	EA		
*** {Severity L}			
b. Dripping shut-off valve.	EA		
*** {Severity M}			
c. Cracked fixture.	EA		
*** {Severity H}			
d. Loose or missing faucet handle/index button.	EA		
*** {Severity L}			
<b>* Loose mounting.</b>			
Observation:			
a. Missing/deteriorated caulking.	EA		
*** {Severity F}			
b. Loose mounting bolts/hardware.	EA		
*** {Severity M}			
c. Missing mounting bolts/hardware.	EA		
*** {Severity H}			
<b>* Deteriorated faucet aerator.</b>			
Observation:			
a. Clogged aerator.	EA		
*** {Severity F}			
b. Missing aerator.	EA		
*** {Severity F}			
<b>* Missing drain grate/stop.</b>			
Observation:			
a. Missing drain grate.	EA		
*** {Severity M}			
b. Missing drain stop.	EA		
*** {Severity M}			
c. Loose or damaged drain linkage.	EA		
*** {Severity M}			

## 07.01 PLUMBING FIXTURES

### COMPONENTS (Continued)

#### ♦ 07.01.05 LAVATORIES, SINKS, CERAMIC DRINKING FOUNTAINS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Corrosion.</b>			
Observation:			
a. Etched or pitted surface of faucet.	EA		
*** {Severity L}			
b. Etched or pitted drain	EA		
piping surface (Not Leaking)			
*** {Severity L}			
c. Etched or pitted porcelain/ceramic	EA		
surface.			
*** {Severity M}			
d. Etched or pitted drain	EA		
piping surface (Leaking)			
*** {Severity H}			
<b>* Malfunctioning drain.</b>			
Observation:			
a. Lavatories/ sinks/fountains drains	EA		
slowly.			
*** {Severity L}			
b. Clogged drain.	EA		
*** {Severity H}			

## 07.01 PLUMBING FIXTURES

### COMPONENTS (Continued)

#### ♦ 07.01.06 SERVICE SINKS AND FLOOR UTILITY SINKS

Service sinks and floor utility sinks are plumbing fixtures consisting of a basin with a water supply and a connected drain. These sinks are designed for custodial or industrial applications.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Leaking/damaged.</b>			
Observation:			
a. Dripping faucets.	EA		
*** {Severity L}			
b. Cracked sink.	EA		
*** {Severity H}			
c. Loose or missing faucet handles/index button.	EA		
*** {Severity L}			
d. Malfunctioning faucets.	EA		
*** {Severity H}			
e. Leaking drain piping.	EA		
*** {Severity H}			
<b>* Malfunctioning drain.</b>			
Observation:			
a. Sink drains slowly.	EA		
*** {Severity L}			
b. Clogged drain.	EA		
*** {Severity H}			
<b>* Defective backflow preventer.</b>			
Observation:			
a. Broken or missing backflow preventer.	EA		
*** {Severity H}			
<b>* Loose/Missing drain grate.</b>			
Observation:			
a. Loose drain grate.	EA		
*** {Severity L}			
b. Missing drain grate.	EA		
*** {Severity M}			

## 07.01 PLUMBING FIXTURES

### COMPONENTS (Continued)

#### ♦ 07.01.06 SERVICE SINKS AND FLOOR UTILITY SINKS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Loose mounting.			
Observation:			
a. Loose mounting bolts/hardware.	EA		
*** {Severity M}			
b. Missing mounting bolts/hardware.	EA		
*** {Severity H}			
c. Loose faucet and pipe mounting.	EA		
*** {Severity H}			
* Corrosion.			
Observation:			
a. Etched or pitted surface of faucet.	EA		
*** {Severity L}			
b. Etched or pitted drain	EA		
piping surface (not leaking).			
*** {Severity L}			
c. Etched or pitted ceramic surface.	EA		
*** {Severity M}			
d. Etched or pitted drain piping surface.	EA		
*** {Severity H}			

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## 07.01 PLUMBING FIXTURES

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### COMPONENTS (Continued)

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#### ♦ 07.01.07 BATHTUBS AND SHOWERS

A bathtub consists of a tub with a water supply and a connected drain. A shower is normally a tiled or molded compartment with a water supply and a connected drain.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Leaking/damaged.</b>			
Observation:			
a. Leaking mixing valve.	EA		
*** {Severity M}			
b. Leaking drain piping.	EA		
*** {Severity H}			
c. Cracked fixture.	EA		
*** {Severity H}			
d. Loose or missing handle/index button.	EA		
*** {Severity L}			
e. Dripping faucets or mixing valve.	EA		
*** {Severity L}			
f. Malfunctioning faucets or mixing valve.	EA		
*** {Severity H}			
<b>* Malfunctioning drain.</b>			
Observation:			
a. Sink drains slowly.	EA		
*** {Severity L}			
b. Clogged drain.	EA		
*** {Severity H}			

## 07.01 PLUMBING FIXTURES

### COMPONENTS (Continued)

#### ♦ 07.01.07 BATHTUBS AND SHOWERS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Loose mounting.</b>			
Observation:			
a. Missing/deteriorated caulking.	EA		
*** {Severity F}			
b. Loose mounting bolts/hardware.	EA		
*** {Severity M}			
c. Missing mounting bolts/hardware.	EA		
*** {Severity H}			
<b>* Missing drain grate/stop.</b>			
Observation:			
a. Broken/missing drain grate.	EA		
*** {Severity M}			
b. Missing drain stop.	EA		
*** {Severity M}			
<b>* Deteriorated shower head.</b>			
Observation:			
a. Clogged shower head.	EA		
*** {Severity H}			
b. Missing shower head.	EA		
*** {Severity H}			
<b>* Corrosion.</b>			
Observation:			
a. Etched or pitted surface of faucet or shower head.	EA		
*** {Severity L}			
b. Etched or pitted ceramic surface.	EA		
*** {Severity M}			

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**07.01 PLUMBING FIXTURES**

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**REFERENCES**

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1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988.
2. NAVFAC MO-322, Vol. II Inspection for Maintenance of Public Works & Public Utilities, 1993
3. American Water Works Association, Manual of Water Supply Practices, M-36, 1990
4. NAVFAC P-717.0, Department of Defense, Engineered Performance Standards for Real Property Maintenance
5. Dictionary of Architecture and Construction, ISBN 0-07-026819-3, McGraw-Hill Book Company, 1975
6. Uniform Plumbing Code, International Association of Plumbing and Mechanical Officials, 1979

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**07.01 PLUMBING FIXTURES**

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**LEVEL II KEYS      GUIDE SHEET CONTROL NUMBER**

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N/A

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**LEVEL III KEYS      GUIDE SHEET CONTROL NUMBER**

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N/A



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## **07.02 DOMESTIC WATER DISTRIBUTION SYSTEMS**

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### **DESCRIPTION**

Domestic Water Distribution Systems is a subsystem of the Building Plumbing System. The system provides hot and cold potable water throughout the building or asset, taking its source from outside the building and terminating at domestic plumbing fixtures.

### **SPECIAL TOOL AND EQUIPMENT REQUIREMENTS**

No special tools are required for the inspection of Domestic Water Distribution Systems, beyond the requirements listed in the Standard Tool Section.

### **SPECIAL SAFETY REQUIREMENTS**

No special safety requirements are needed for the inspection of Domestic Water Distribution Systems, beyond the requirements listed in the Master Safety Plan and System Safety Section.

### **COMPONENT LIST**

- ◆ 07.02.01 HOT WATER CIRCULATING PUMPS
- ◆ 07.02.02 WATER HEATERS
- ◆ 07.02.03 HEAT EXCHANGERS
- ◆ 07.02.04 PIPING, FITTINGS AND VALVES
- ◆ 07.02.05 BACKFLOW PREVENTERS

### **RELATED SUBSYSTEMS**

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities.

- 07.01 PLUMBING FIXTURES
- 23.01 POTABLE WATER DISTRIBUTION SYSTEMS

## 07.02 DOMESTIC WATER DISTRIBUTION SYSTEMS

### STANDARD INSPECTION PROCEDURE

This subsystem requires both Level I and Level II inspection as part of the basic inspection process. Additional Level II inspections may be indicated or "triggered" by the Level I inspection observation and should be accomplished by the inspector at that time. Associated defects and observations, for each major component, are listed in the Field CAIS.

The Facility Manager will authorize any Level III inspection he feels necessary for specialized pump and motor applications.

### COMPONENTS

#### ♦ 07.02.01 HOT WATER CIRCULATING PUMPS

The hot water circulating pumps circulate hot water throughout the facility.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Leakage.</b>			
Observation:			
a. Leaking at pump, fittings or seals.	EA		
*** {Severity M}			
b. Cracked or damaged pump housing.	EA		
*** {Severity H}			
<b>* Damaged motor.</b>			
Observation:			
a. Cracked/damaged housing or end bells.	EA		
*** {Severity H}			
b. Grinding noise, indicating metal to metal contact.	EA	1	1
*** {Severity H}			
c. Electrical arcing noise.	EA		2
*** {Severity H}			
<b>* Defective electrical connectors.</b>			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity F}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity F}			

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**07.02 DOMESTIC WATER DISTRIBUTION SYSTEMS**

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**COMPONENTS (Continued)**

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**♦ 07.02.01 HOT WATER CIRCULATING PUMPS (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Corrosion.</b>			
Observation:			
a. Surface corrosion no pitting evident.	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Mineral deposits on pump housing	SF		
*** {Severity M}			
d. Corrosion evidenced by holes or loss of base metal.	SF		
*** {Severity H}			

## 07.02 DOMESTIC WATER DISTRIBUTION SYSTEMS

### COMPONENTS (Continued)

#### ♦ 07.02.02 WATER HEATERS

A water heater is a device for producing and storing hot water, normally using steam, gas or electricity as an energy source.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Defective flue.</b>			
Observation:			
a. Flue duct damaged/loose.	LF		
*** {Severity M}			
b. Flue duct missing.	LF		
*** {Severity H}			
<b>* Damaged enclosure.</b>			
Observation:			
a. Loose enclosure panels.	SF		
*** {Severity L}			
b. Distorted or physically damaged enclosure.	SF		
*** {Severity M}			
c. Missing enclosure panels.	SF		
*** {Severity H}			
<b>* Defective electrical connectors.</b>			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity F}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity F}			
<b>* Water or steam leakage.</b>			
Observation:			
a. Water or steam dripping from fitting.	EA		
*** {Severity L}			
b. Water dripping from inside enclosure.	EA		
*** {Severity M}			
c. Water or steam dripping from gasket.	EA		
*** {Severity H}			
d. Water running from pressure relief valve.	EA		
*** {Severity H}			

## 07.02 DOMESTIC WATER DISTRIBUTION SYSTEMS

### COMPONENTS (Continued)

#### ♦ 07.02.02 WATER HEATERS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Defective gauge.</b>			
Observation:			
a. Broken gauge lens.	EA		
*** {Severity L}			
b. Inoperative gauge, no reading.	EA		
*** {Severity H}			
c. Discharge water temperature less than 140 °F.	EA		3
*** {Severity H}			
d. Leaking temperature gauge.	EA		
*** {Severity H}			
<b>* Corrosion.</b>			
Observation:			
a. Surface corrosion no pitting evident.	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	SF		
*** {Severity H}			

## 07.02 DOMESTIC WATER DISTRIBUTION SYSTEMS

### COMPONENTS (Continued)

#### ♦ 07.02.03 HEAT EXCHANGERS

A heat exchanger is a device which transfers heat between two physically separated fluids, normally using steam or water as an energy source.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Water or steam leakage.</b>			
Observation:			
a. Water or steam dripping from fitting. *** {Severity L}	EA		
b. Water or steam dripping from gasket. *** {Severity H}	EA		
<b>* Defective gauge.</b>			
Observation:			
a. Broken gauge lens. *** {Severity L}	EA		
b. Inoperative gauge, no reading. *** {Severity H}	EA		
c. Leaking temperature gauge. *** {Severity H}	EA		
d. Discharge water temperature less than 140 °F. *** {Severity H}	EA		4
<b>* Deteriorated heat exchanger insulation.</b>			
Observation:			
a. Loose insulation. *** {Severity L}	SF		
b. Damaged or missing insulation. *** {Severity H}	SF		
<b>* Corrosion.</b>			
Observation:			
a. Surface corrosion no pitting evident. *** {Severity L}	SF		
b. Corrosion evidenced by pitting or blistering. *** {Severity M}	SF		
c. Corrosion evidenced by holes or loss of base metal. *** {Severity H}	SF		

## 07.02 DOMESTIC WATER DISTRIBUTION SYSTEMS

### COMPONENTS (Continued)

#### ♦ 07.02.04 PIPING, FITTINGS AND VALVES

Piping and fittings provide the distribution network for the domestic water distribution system. Wherever dissimilar metals are used, dielectric unions should be provided to avoid galvanic action and prohibit corrosion. Valves are installed to control the water supply, isolate system parts, and provide a means for drainage.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Leaking/damaged fittings.</b>			
Observation:			
a. Bent or cracked fitting, not leaking.	EA		
*** {Severity L}			
b. Water leaking.	EA		
*** {Severity H}			
<b>* Leaking/damaged pipe.</b>			
Observation:			
a. Bent or cracked pipe, not leaking.	LF		
*** {Severity L}			
b. Water leaking.	LF		
*** {Severity H}			
<b>* Leaking/damaged valves.</b>			
Observation:			
a. Broken or missing valve handle.	EA		
*** {Severity L}			
b. Bent stem.	EA		
*** {Severity M}			
c. Leaking valve packing glands/gaskets.	EA		
*** {Severity M}			
d. Cracked valve body.	EA		
*** {Severity H}			
<b>* Loose/missing supports/hangers.</b>			
Observation:			
a. Loose supports or hangers.	EA		
*** {Severity L}			
b. Broken or missing supports or hangers.	EA		
*** {Severity H}			

## 07.02 DOMESTIC WATER DISTRIBUTION SYSTEMS

### COMPONENTS (Continued)

#### ♦ 07.02.04 PIPING, FITTINGS AND VALVES (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Defective insulation.</b>			
Observation:			
a. Loose insulation.	LF		
*** {Severity L}			
b. Damaged or missing insulation.	LF		
*** {Severity H}			
<b>* Corroded piping and fittings</b>			
Observation:			
a. Surface corrosion no pitting evident.	LF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	LF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	LF		
*** {Severity H}			
<b>* Corroded hangers or supports.</b>			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			



## 07.02 DOMESTIC WATER DISTRIBUTION SYSTEMS

### COMPONENTS (Continued)

#### ♦ 07.02.05 BACKFLOW PREVENTERS

A Backflow Preventer is a device used to prevent water (or other liquids) from being siphoned into a potable water system.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Leaking.</b>			
Observation:			
a. Leaking valve packing glands/gaskets. *** {Severity H}	EA		
b. Leaking relief vent. *** {Severity H}	EA		6
c. Continuous discharge of water through differential relief valve. *** {Severity H}	EA		6
d. Cracked valve body. *** {Severity H}	EA		
<b>* Defective insulation.</b>			
Observation:			
a. Loose insulation. *** {Severity L}	EA		
b. Damaged or missing insulation. *** {Severity H}	EA		
<b>* Corrosion</b>			
Observation:			
a. Surface corrosion no pitting evident. *** {Severity L}	EA		
b. Corrosion evidenced by pitting or blistering. *** {Severity M}	EA		
c. Corrosion evidenced by holes or loss of base metal. *** {Severity H}	EA		

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## **07.02 DOMESTIC WATER DISTRIBUTION SYSTEMS**

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### **REFERENCES**

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1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988
2. NAVFAC MO-322, Vol. II Inspection for Maintenance of Public Works & Public Utilities, 1993
3. American Water Works Association, Manual of Water Supply Practices, M-36, 1990
4. NAVFAC P-717.0, Department of Defense, Engineered Performance Standards for Real Property Maintenance Activities
5. Uniform Plumbing Code, International Association of Plumbing and Mechanical Officials
6. Fire Protection Handbook, National Fire Protection Association, 1979

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**07.02 DOMESTIC WATER DISTRIBUTION SYSTEMS**

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**LEVEL II KEYS    GUIDE SHEET CONTROL NUMBER**

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1	GS-II 07.02.01-1
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**LEVEL III KEYS    GUIDE SHEET CONTROL NUMBER**

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1	GS-III 07.02.01-1
2	GS-III 07.02.01-2
3	GS-III 07.02.02-3
4	GS-III 07.02.03-4
5 *	GS-III 07.02.04-5 *
6	GS-III 07.02.05-6

\* Indicates guide sheets which are not directly referenced by a Key. These Level III Inspection Methods can be implemented, by the Facility Manager, based on an analysis of equipment operating time, equipment age, suspected hidden problems or repeated service calls that indicate a problem exists.

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**LEVEL II INSPECTION METHOD GUIDE SHEET**

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**LEVEL II GUIDE SHEET - KEY NO. 1**

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**COMPONENT:** MOTORS  
**CONTROL NUMBER:** GS-II 07.02.01-1

**Application**

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the motor, if 60 HP or greater in size.

**Special Safety Requirements**

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.
2. Always have one person standing by outside when someone is working inside a confined area.

**Inspection Actions**

1. Observe motor operation and determine possible source of noise.
2. Shut down motor, tag and lock out disconnect.
3. Check coupling for wear, damage or loose fasteners.
4. Visually check interior of motor housing for other physical damage, if an open motor.
5. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
6. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
7. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

**Recommended Inspection Frequency**

Perform inspection when triggered by a Level I or other local factors such as problematic conditions.

**References**

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

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**LEVEL III INSPECTION METHOD GUIDE SHEET**

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**LEVEL III GUIDE SHEET - KEY NO. 1**

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**COMPONENT:** MOTORS  
**CONTROL NUMBER:** GS-III 07.02.01-1

**Application**

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the motor, if 60 HP or greater in size.

**Special Safety Requirements**

The following is a list of special requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.
2. Always have one person standing outside when someone is working inside a confined area.

**Inspection Actions**

1. Observe motor operation and determine possible source of noise.
2. Perform vibration analysis on motor bearings.
3. Shut down motor, tag and lock out disconnect.
4. Rotate (cycle) motor to check for binding.
5. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
6. Open and inspect motor interior housing for cracks, fatigue, erosion and corrosion, check suspicious areas with dye penetrant.
7. Check interior shafting for signs of fatigue or wear.
8. Rotate (cycle) shafting and check for distortion.
9. Document the problem and contact appropriate facility personnel for further instructions and reassemble motor, if directed.
10. Notify appropriate personnel for permission to place unit back in service if defect is not critical to continued function.
11. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

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**LEVEL III INSPECTION METHOD GUIDE SHEET**

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**LEVEL III GUIDE SHEET - KEY NO. 1 (Continued)**

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**COMPONENT:** MOTORS  
**CONTROL NUMBER:** GS-III 07.02.01-1

**Special Tools and Equipment**

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Alignment Tools
2. Vibration Tester
3. Dye Penetrant

**Recommended Inspection Frequency**

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

**References**

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988
2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

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**LEVEL III INSPECTION METHOD GUIDE SHEET**

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**LEVEL III GUIDE SHEET - KEY NO. 2**

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**COMPONENT:** MOTORS  
**CONTROL NUMBER:** GS-III 07.02.01-2

**Application**

This guide applies to the investigation of electrical arcing noise from the motor, if 60 HP or greater in size.

**Special Safety Requirements**

The following is a list of special requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.
2. Always have one person standing outside when someone is working inside a confined area.

**Inspection Actions**

1. Observe motor operation and determine possible source of noise.
2. Check voltage at motor and current draw. Compare to motor ratings and the requirements of the associated equipment.
3. Perform vibration analysis on the motor.
4. Rotate motor shaft and check for binding, rubbing.
5. Measure run-out play in bearings due to wear; compare with manufacturer's specification.
6. Check alignment.
7. Shut down motor and lock out disconnect.
8. Open motor and inspect interior housing for stress cracks, corrosion, other physical damage, check suspicious areas with dye penetrant.
9. Check stator windings for dirt, moisture, physical damage, signs of overheating, loose fasteners.
10. Check rotor windings for dirt, moisture, physical damage, signs of overheating, loose fasteners.
11. Check commutator/slip rings for loose parts, physical damage, wear.
12. Check brushes for wear, proper tension.
13. Check bearings for lube leakage into motor.
14. Check motor shafting for wear.
15. Document the problem and contact appropriate facility personnel for further instructions and reassemble motor, if directed.
16. Notify appropriate personnel for permission to place unit back in service if defect is not critical to continued function.
17. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

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**LEVEL III INSPECTION METHOD GUIDE SHEET**

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**LEVEL III GUIDE SHEET - KEY NO. 2 (Continued)**

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**COMPONENT:** MOTORS  
**CONTROL NUMBER:** GS-III 07.02.01-2

**Special Tools and Equipment**

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Alignment Tools
2. Vibration Tester
3. Infrared Temperature Tester
4. Ammeter
5. Voltmeter
6. Dye Penetrant

**Recommended Inspection Frequency**

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

**References**

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988
2. Electric Motor & Contracting Co. Inc., Chesapeake, Va



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**LEVEL III INSPECTION METHOD GUIDE SHEET**

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**LEVEL III GUIDE SHEET - KEY NO. 3**

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**COMPONENT:** WATER HEATERS  
**CONTROL NUMBER:** GS-III 07.02.02-3

**Application**

This guide applies to the checking of low water temperature in steam heated hot water heaters.

**Special Safety Requirements**

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

**Inspection Actions**

1. Isolate hot water heater and take out of service.
2. Tag and lockout steam, fuel and water valves to hot water heater.
3. Drain the water from the hot water heater.
4. Remove heating unit from water tank.
5. Inspect coils or tubes for scaling or mineral build-up or other defects.
6. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determine or is major.
8. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
9. Remove tags and lockouts.
10. Return hot water heater to normal service according to the manufacturer's recommendations.

**Recommended Inspection Frequency**

Perform inspection when triggered by Level I inspections or other local factors such as problematic conditions.

**References**

1. NAVFAC MO-322, Vol. II Inspection of Shore Facilities, 1993
2. Means Facilities Maintenance Standards, Roger W. Liska, P.E., AIC, 1988

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**LEVEL III INSPECTION METHOD GUIDE SHEET**

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**LEVEL III GUIDE SHEET - KEY NO. 4**

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**COMPONENT:** HEAT EXCHANGERS  
**CONTROL NUMBER:** GS-III 07.02.03-4

**Application**

This guide applies to the checking of low water temperature in steam heated exchangers.

**Special Safety Requirements**

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

**Inspection Actions**

1. Isolate heat exchanger and take out of service.
2. Tag and lockout steam and water valves to heat exchanger.
3. Drain the water from the heat exchanger.
4. Remove heating unit from heat exchanger.
5. Inspect coils or tubes for scaling or mineral build-up or other defects.
6. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determine or is major.
8. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
9. Remove tags and lockouts.
10. Return heat exchanger to normal service according to the manufacturer's recommendations.

**Recommended Inspection Frequency**

Perform inspection when triggered by Level I inspections or other local factors such as problematic conditions.

**References**

1. NAVFAC MO-322, Vol. II Inspection of Shore Facilities, 1993
2. Means Facilities Maintenance Standards, Roger W. Liska, P.E., AIC, 1988

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**LEVEL III INSPECTION METHOD GUIDE SHEET**

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**LEVEL III GUIDE SHEET - KEY NO. 5\***

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**COMPONENT:** PIPING, FITTINGS AND VALVES**CONTROL NUMBER:** GS-III 07.02.04-5\***Application**

This guide applies to the use of an ultrasonic thickness gauge to determine sediment buildup or detect internal flaws and corrosion of the walls in piping, fittings and valves.

**Special Safety Requirements**

No special safety requirements are needed for the performance of this Level III inspection beyond those listed in the Master Safety Plan and System Safety Section.

**Inspection Actions**

1. Use the ultrasonic thickness testing device to measure the wall thickness of the suspected area.
2. Document the readings and compare to wall thickness of piping in ASTM manual to determine if piping/fittings and defective or damaged.

**Special Tools and Equipment**

1. Ultrasonic Thickness Gauge

**Recommended Inspection Frequency**

This inspection should be performed at the direction of the facility manager on a five year cycle or other periodic basis when the desired degree of reliability justifies the procedure.

**References**

1. EPD Technology Corporation, 12 W. Main Street, Elmsford, New York 10523
2. Means Facility Maintenance & Repair Cost Data 1994

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**LEVEL III INSPECTION METHOD GUIDE SHEET**

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**LEVEL III GUIDE SHEET - KEY NO. 6**

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**COMPONENT:** BACKFLOW PREVENTERS**CONTROL NUMBER:** GS-III 07.02.05-6**Application**

This guide applies to the investigation for the proper operation of the backflow prevention device. Do not duplicate this effort if it is being performed under an existing base PM or recurring maintenance program.

**Special Safety Requirements**

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

**Inspection Actions**

1. Inspect the assembly for the required components for the field test procedure - i.e., upstream and downstream shut-off valves, properly placed test cocks.
2. Observe the area around the assembly for telltale signs of leakage.
3. Perform the appropriate test of the backflow device.
4. Document the test results and contact the appropriate facility personnel for further instructions, if defect cannot be determined or is major.
5. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
6. Ensure all guards and covers have been installed; remove tags, replace lockouts on valves and restore unit to service.

**Special Tools and Equipment**

1. Properly calibrated differential pressure gauge or duplex gauge.
2. 3 - 6 ft. lengths - minimum 1/4" I.D. high pressure hose with screw couplings.
3. Adapter fittings for each test cock size - brass 1/8" x 1/4", 1/4" x 1/2", 1/4" x 3/4".
4. 3 - 1/4" IPS x inverted flare - brass or 1/4" IPS x 45 degrees SAE flare connector - brass.

**Recommended Inspection Frequency**

Minimum Annually

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**LEVEL III INSPECTION METHOD GUIDE SHEET**

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**LEVEL III GUIDE SHEET - KEY NO. 6 (Continued)**

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**COMPONENT:** BACKFLOW PREVENTERS  
**CONTROL NUMBER:** GS-III 07.02.05-6

**References**

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC 1988
2. Manual of Cross Connection Control, Vol. Eighth Edition, 1988
3. Jim Bertolino Plumbing & Drain Service, Virginia Beach, VA

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## **07.03 SANITARY COLLECTION SYSTEMS**

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### **DESCRIPTION**

Sanitary Collection Systems is a subsystem of the Building Plumbing system. The system provides for the collection and transfer of the wastewater to a point of disposal.

### **SPECIAL TOOL AND EQUIPMENT REQUIREMENTS**

No special tools are required for the inspection of Sanitary Collection Systems, beyond the requirements listed in the Standard Tools Section.

### **SPECIAL SAFETY REQUIREMENTS**

No special safety requirements are needed for the inspection of Sanitary Collection Systems, beyond the requirements listed in the Master Safety Plan and System Safety Section.

### **COMPONENT LIST**

- ◆ 07.03.01 PIPING, FITTINGS AND VALVES
- ◆ 07.03.02 SUMP PUMP SYSTEMS
- ◆ 07.03.03 GREASE TRAPS
- ◆ 07.03.04 OIL AND GASOLINE INTERCEPTORS

### **RELATED SUBSYSTEMS**

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities.

07.08 ACID WASTE COLLECTION SYSTEMS

## 07.03 SANITARY COLLECTION SYSTEMS

### STANDARD INSPECTION PROCEDURE

This subsystem requires both Level I and Level II inspection as part of the basic inspection process. Additional Level II inspections may be indicated or "triggered" by the Level I inspection observation and should be accomplished by the inspector at that time. Associated defects and observations, for each major component, are listed in the Field CAIS.

The Facility Manager will authorize any Level III inspection he feels necessary for specialized pump and motor applications.

### COMPONENTS (Continued)

#### ♦ 07.03.01 PIPING, FITTINGS AND VALVES

Piping, fittings (including floor drains) and valves provide the network for the sanitary collection system.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Leaking/damaged fitting.			
Observation:			
a. Bent or cracked fitting, not leaking.	EA		
*** {Severity L}			
b. Water leaking.	EA		
*** {Severity H}			
c. Broken/missing floor drain grate.	EA		
*** {Severity M}			
* Leaking/damaged pipe.			
Observation:			
a. Bent or cracked pipe, not leaking.	LF		
*** {Severity L}			
b. Water leaking.	LF		
*** {Severity H}			
* Loose/missing supports/hangers.			
Observation:			
a. Loose supports or hangers.	EA		
*** {Severity L}			
b. Broken or missing supports or hangers.	EA		
*** {Severity H}			

## 07.03 SANITARY COLLECTION SYSTEMS

### COMPONENTS (Continued)

#### ◆ 07.03.01 PIPING, FITTINGS AND VALVES (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Corroded piping and fittings</b>			
Observation:			
a. Surface corrosion no pitting evident.	LF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	LF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	LF		
*** {Severity H}			
<b>* Corroded hangers or supports.</b>			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			



## 07.03 SANITARY COLLECTION SYSTEMS

### COMPONENTS

#### ◆ 07.03.02 SUMP PUMP SYSTEMS

A sump is an approved tank or pit which receives sewage or liquid waste. It is located below the normal grade and must be emptied by single or duplex sump pumps or sewage ejectors that are controlled by float or pressure switches.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Cracking or spalling of pit concrete.</b>			
Observation:			
a. Cracks greater than 1/4"	LF		
*** {Severity H}			
b. Loss of more than 10 percent of surface area of a wall.	SF		
*** {Severity H}			
c. Extensive disintegration of surface area, with corrosion of exposed reinforcing steel.	SF		
*** {Severity H}			
<b>* Bowing or leaning concrete pit wall.</b>			
Observation:			
a. Wall out of alignment greater than 2" less than 3" per wall.	SF		
*** {Severity M}			
b. Wall out of alignment greater than 3" per wall.	SF		
*** {Severity H}			
<b>* Deteriorated concrete pit joint sealant/caulk.</b>			
Observation:			
a. Cracked joint sealant/caulk.	LF		
*** {Severity L}			
b. Separated/missing joint sealant/caulk.	LF		
*** {Severity H}			
<b>* Loose/missing cover/grate.</b>			
Observation:			
a. Loose cover or grate	EA		
*** {Severity L}			
b. Missing or damaged cover or grate	SF		
*** {Severity H}			

## 07.03 SANITARY COLLECTION SYSTEMS

### COMPONENTS

#### ◆ 07.03.02 SUMP PUMP SYSTEMS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Corrosion of steel tank.</b>			
Observation:			
a. Surface corrosion no pitting evident.	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	SF		
*** {Severity H}			
<b>* Loose/missing pump or motor mounting hardware.</b>			
Observation:			
a. Loose pump or motor tie-down bolts.	EA		
*** {Severity M}			
b. Missing pump or motor tie-down bolts or isolators.	EA		
*** {Severity H}			
<b>* Defective ejector.</b>			
Observation:			
a. Control system failure.	EA		
*** {Severity H}			
b. Loss of air pressure.	EA		
*** {Severity F}			
<b>* Damaged motor.</b>			
Observation:			
a. Cracked/damaged housing or end bells.	EA		
*** {Severity M}			
b. Broken motor base.	EA		
*** {Severity H}			

## 07.03 SANITARY COLLECTION SYSTEMS

### COMPONENTS

#### ♦ 07.03.02 SUMP PUMP SYSTEMS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Excessive noise and vibration at motor.</b>			
Observation:			
a. Rattling noise. *** {Severity M}	EA	1	2
b. Grinding noise, indicating metal to metal contact. *** {Severity H}	EA	1	2
c. Electrical arcing noise. *** {Severity H}	EA		3
<b>* Broken/loose motor hardware.</b>			
Observation:			
a. Loose motor assembly bolts. *** {Severity L}	EA		
b. Broken or missing motor inspection covers. *** {Severity M}	EA		
<b>* Defective electrical connectors.</b>			
Observation:			
a. Loose conduit or connectors. *** {Severity F}	EA		
b. Exposed wires or missing cover plates. *** {Severity F}	EA		
<b>* Physically damaged controls.</b>			
Observation:			
a. Control panel blocked, not accessible for inspection. *** {Severity S}	EA		
b. Missing controls. *** {Severity M}	EA		
c. Loose controls. *** {Severity F}	EA		

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**07.03 SANITARY COLLECTION SYSTEMS**

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**COMPONENTS**

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**♦ 07.03.02 SUMP PUMP SYSTEMS (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Corrosion.</b>			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			

## 07.03 SANITARY COLLECTION SYSTEMS

### COMPONENTS (Continued)

#### ◆ 07.03.03 GREASE TRAPS

A device for removing grease from the waste water by allowing the retained liquid to cool and the grease to solidify. The grease is normally separated by flotation.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Leaking grease trap.</b>			
Observation:			
a. Loose access panel bolts.	EA		
*** {Severity M}			
b. Missing access panel bolts.	EA		
*** {Severity H}			
c. Missing/damaged access panel.	EA		
*** {Severity H}			
<b>* Corrosion.</b>			
Observation:			
a. Surface corrosion no pitting evident.	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	SF		
*** {Severity H}			

## 07.03 SANITARY COLLECTION SYSTEMS

### COMPONENTS (Continued)

#### ♦ 07.03.04 OIL AND GASOLINE INTERCEPTORS

A device for removing oil and gasoline from the waste water by allowing the retained liquid to rise to the surface, to a separate holding tank for disposition.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Leaking interceptor.</b>			
Observation:			
a. Missing/damaged access panel.	EA		
*** {Severity M}			
b. Loose access panel bolts.	EA		
*** {Severity M}			
c. Missing access panel bolts.	EA		
*** {Severity H}			
<b>* Corrosion.</b>			
Observation:			
a. Surface corrosion no pitting evident.	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	SF		
*** {Severity H}			

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**07.03 SANITARY COLLECTION SYSTEMS**

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**REFERENCES**

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1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988
2. NAVFAC MO-322, Vol. II Inspection for Maintenance of Public Works & Public Utilities, 1993
3. American Water Works Association, Manual of Water Supply Practices, M-36, 1990
4. NAVFAC P-717.0, Department of Defense, Engineered Performance Standards for Real Property Maintenance Activities
5. Uniform Plumbing Code, International Association of Plumbing and Mechanical Officials, 1979

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**07.03 SANITARY COLLECTION SYSTEMS**

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**LEVEL II KEY: GUIDE SHEET REFERENCE**

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1	GS-II 07.03.02-1
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**LEVEL III KEY: GUIDE SHEET REFERENCE**

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1 *	GS-III 07.03.01-1 *
2	GS-III 07.03.02-2
3	GS-III 07.03.02-3

- \* Indicates guide sheets which are not directly referenced by a Key. These Level III Inspection Methods can be implemented, by the Facility Manager, based on an analysis of equipment operating time, equipment age, suspected hidden problems or repeated service calls that indicate a problem exists.



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**LEVEL II INSPECTION METHOD GUIDE SHEET**

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**LEVEL II GUIDE SHEET - KEY NO. 1**

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**COMPONENT:** MOTORS  
**CONTROL NUMBER:** GS-II 07.03.02-1

**Application**

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the motor, if 60 HP or greater in size.

**Special Safety Requirements**

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.
2. Always have one person standing by outside when someone is working inside a confined area.

**Inspection Actions**

1. Observe motor operation and determine possible source of noise.
2. Shut down motor, tag and lock out disconnect.
3. Check coupling for wear, damage or loose fasteners.
4. Visually check interior of motor housing for other physical damage, if an open motor.
5. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
6. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
7. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

**Recommended Inspection Frequency**

Perform inspection when triggered by a Level I or other local factors such as problematic conditions.

**References**

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

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**LEVEL III INSPECTION METHOD GUIDE SHEET**

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**LEVEL III GUIDE SHEET - KEY NO. 1\***

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**COMPONENT:** PIPING, FITTINGS AND VALVES**CONTROL NUMBER:** GS-III 07.03.01-1\***Application**

This guide applies to the use of an ultrasonic thickness gauge to determine sediment buildup or detect internal flaws and corrosion of the walls in piping, fittings and valves.

**Special Safety Requirements**

No special safety requirements are needed for the performance of this Level III inspection beyond those listed in the Master Safety Plan and System Safety Section.

**Inspection Actions**

1. Use the ultrasonic thickness testing device to measure the wall thickness of the suspected area.
2. Document the readings and compare to wall thickness of piping in ASTM manual to determine if piping/fittings are defective or damaged.

**Special Tools and Equipment**

1. Ultrasonic Thickness Gauge

**Recommended Inspection Frequency**

This inspection should be performed at the direction of the facility manager on a five year cycle or other periodic basis when the desired degree of reliability justifies the procedure.

**References**

1. EPD Technology Corporation, 12 W. Main Street, Elmsford, New York 10523.
2. Means Facilities Maintenance & Repair Cost Data 1994.

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**LEVEL III INSPECTION METHOD GUIDE SHEET**

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**LEVEL III GUIDE SHEET - KEY NO. 2**

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**COMPONENT:** MOTORS  
**CONTROL NUMBER:** GS-III 07.03.02-2

**Application**

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the motor, if 60 HP or greater in size.

**Special Safety Requirements**

The following is a list of special requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.
2. Always have one person standing outside when someone is working inside a confined area.

**Inspection Actions**

1. Observe motor operation and determine possible source of noise.
2. Perform vibration analysis on motor bearings.
3. Shut down motor, tag and lock out disconnect.
4. Rotate (cycle) motor to check for binding.
5. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
6. Open and inspect motor interior housing for cracks, fatigue, erosion and corrosion, check suspicious areas with dye penetrant.
7. Check interior shafting for signs of fatigue or wear.
8. Rotate (cycle) shafting and check for distortion.
9. Document the problem and contact appropriate facility personnel for further instructions and reassemble motor, if directed.
10. Notify appropriate personnel for permission to place unit back in service if defect is not critical to continued function.
11. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

**Special Tools and Equipment**

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Alignment Tools
2. Vibration Tester
3. Dye Penetrant

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**LEVEL III INSPECTION METHOD GUIDE SHEET**

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**LEVEL III GUIDE SHEET - KEY NO. 2 (Continued)**

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**COMPONENT:** MOTORS  
**CONTROL NUMBER:** GS-III 07.03.02-2

**Recommended Inspection Frequency**

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

**References**

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988
2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

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**LEVEL III INSPECTION METHOD GUIDE SHEET**

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**LEVEL III GUIDE SHEET - KEY NO. 3**

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**COMPONENT:** MOTORS  
**CONTROL NUMBER:** GS-III 07.03.02-3

**Application**

This guide applies to the investigation of electrical arcing noise from the motor, if 60 HP or greater in size.

**Special Safety Requirements**

The following is a list of special requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.
2. Always have one person standing outside when someone is working inside a confined area.

**Inspection Actions**

1. Observe motor operation and determine possible source of noise.
2. Check voltage at motor and current draw. Compare to motor ratings and the requirements of the associated equipment.
3. Perform vibration analysis on the motor.
4. Rotate motor shaft and check for binding, rubbing.
5. Measure run-out play in bearings due to wear; compare with manufacturer's specification.
6. Check alignment.
7. Shut down motor and lock out disconnect.
8. Open motor and inspect interior housing for stress cracks, corrosion, other physical damage, check suspicious areas with dye penetrant.
9. Check stator windings for dirt, moisture, physical damage, signs of overheating, loose fasteners.
10. Check rotor windings for dirt, moisture, physical damage, signs of overheating, loose fasteners.
11. Check commutator/slip rings for loose parts, physical damage, wear.
12. Check brushes for wear, proper tension.
13. Check bearings for lube leakage into motor.
14. Check motor shafting for wear.
15. Document the problem and contact appropriate facility personnel for further instructions and reassemble motor, if directed.
16. Notify appropriate personnel for permission to place unit back in service if defect is not critical to continued function.
17. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

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**LEVEL III INSPECTION METHOD GUIDE SHEET**

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**LEVEL III GUIDE SHEET - KEY NO. 3 (Continued)**

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**COMPONENT:** MOTORS  
**CONTROL NUMBER:** GS-III 07.03.02-3

**Special Tools and Equipment**

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Alignment Tools
2. Vibration Tester
3. Infrared Temperature Tester
4. Ammeter
5. Voltmeter
6. Dye Penetrant

**Recommended Inspection Frequency**

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

**References**

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988
2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

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## **07.04 STORM WATER COLLECTION SYSTEMS**

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### **DESCRIPTION**

The Storm Water Collection System is a subsystem of the Building Plumbing System. The system provides for the collection and transport of rainwater or other similar discharges, but not sewage or industrial waste to a point of disposal.

### **SPECIAL TOOL AND EQUIPMENT REQUIREMENTS**

No special tools are required for the inspection of Storm Water Collection Systems, beyond the requirements listed in the Standard Tools Section.

### **SPECIAL SAFETY REQUIREMENTS**

No special safety requirements are needed for the inspection of Storm Water Collection Systems, beyond the requirements listed in the Master Safety Plan and System Safety Section.

### **COMPONENT LIST**

- ◆ 07.04.01 PIPING AND FITTINGS
- ◆ 07.04.02 SUMP PUMP SYSTEMS
- ◆ 07.04.03 DRY WELLS

### **RELATED SUBSYSTEMS**

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities.

23.03 STORM WATER DISTRIBUTION SYSTEMS

## 07.04 STORM WATER COLLECTION SYSTEMS

### STANDARD INSPECTION PROCEDURE

This subsystem requires a Level I inspection as part of the basic inspection process. Associated defects and observations, for each major component, are listed in the Field CAIS.

### COMPONENTS

#### ♦ 07.04.01 PIPING AND FITTINGS

Piping and fittings provide the network for the storm water collection system.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Leaking/damaged fitting.</b>			
Observation:			
a. Bent or cracked fitting, not leaking.	EA		
*** {Severity L}			
b. Water leaking.	EA		
*** {Severity H}			
<b>* Leaking/damaged pipe.</b>			
Observation:			
a. Bent or cracked pipe, not leaking.	LF		
*** {Severity L}			
b. Water leaking.	LF		
*** {Severity H}			
<b>* Loose/missing supports/hangers.</b>			
Observation:			
a. Loose supports or hangers.	EA		
*** {Severity L}			
b. Broken or missing supports or hangers.	EA		
*** {Severity H}			
<b>* Corroded piping and fittings</b>			
Observation:			
a. Surface corrosion no pitting evident.	LF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	LF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	LF		
*** {Severity H}			



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**07.04 STORM WATER COLLECTION SYSTEMS**

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**COMPONENTS (Continued)**

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**♦ 07.04.01 PIPING AND FITTINGS (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Corroded hangers or supports.</b>			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			

## 07.04 STORM WATER COLLECTION SYSTEMS

### COMPONENTS (Components)

#### ◆ 07.04.02 SUMP PUMP SYSTEMS

A sump is a tank or pit which receives storm water and/or subsurface water. It is located below the normal grade and must be emptied by single or duplex sump pumps that are controlled by float or pressure switches.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Cracking or spalling of pit concrete.</b>			
Observation:			
a. Cracks greater than 1/4". *** {Severity H}	LF		
b. Loss of more than 10 percent of surface area of a wall. *** {Severity H}	SF		
c. Extensive disintegration of surface area, with corrosion of exposed reinforcing steel. *** {Severity H}	SF		
<b>* Bowing or leaning concrete pit wall.</b>			
Observation:			
a. Wall out of alignment greater than 2" less than 3" per wall. *** {Severity M}	SF		
b. Wall out of alignment greater than 3" per wall. *** {Severity H}	SF		
<b>* Corrosion of steel tank.</b>			
Observation:			
a. Surface corrosion no pitting evident. *** {Severity L}	SF		
b. Corrosion evidenced by pitting or blistering.SF *** {Severity M}	SF		
c. Corrosion evidenced by holes or loss of base metal. *** {Severity H}	SF		

## 07.04 STORM WATER COLLECTION SYSTEMS

### COMPONENTS (Components)

#### ♦ 07.04.02 SUMP PUMP SYSTEMS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Loose/missing cover/grate.</b>			
Observation:			
a. Loose cover or grate.	EA		
*** {Severity L}			
b. Missing or damaged cover or grate.	SF		
*** {Severity H}			
<b>* Loose/missing pump or motor mounting hardware.</b>			
Observation:			
a. Loose pump or motor tie-down bolts.	EA		
*** {Severity M}			
b. Missing pump or motor tie-down bolts or isolators.	EA		
*** {Severity H}			
<b>* Damaged motor.</b>			
Observation:			
a. Cracked/damaged housing or end bells.	EA		
*** {Severity H}			
b. Broken motor base.	EA		
*** {Severity H}			
<b>* Defective electrical connectors.</b>			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity F}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity F}			
<b>* Physically damaged controls.</b>			
Observation:			
a. Loose, deformed or binding linkage	EA		
*** {Severity F}			
b. Missing controls.	EA		
*** {Severity M}			
c. Controls blocked, not accessible for inspection.	EA		
*** {Severity S}			
d. Malfunctioning level control mechanism.	EA		
*** {Severity H}			

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**07.04 STORM WATER COLLECTION SYSTEMS**

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**COMPONENTS (Components)**

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**♦ 07.04.02 SUMP PUMP SYSTEMS (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Corrosion.</b>			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			

## 07.04 STORM WATER COLLECTION SYSTEMS

### COMPONENTS (Continued)

#### ◆ 07.04.03 DRY WELLS

A covered pit either with open-jointed lining or filled with coarse aggregate through which drainage from roofs, basement floors, foundation drain tiles, or areaways may seep or leach into the surrounding soil.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Cracking or spalling of concrete walls.</b>			
Observation:			
a. Wide cracks, between 1/16" and 1/4" wide.	LF		
*** {Severity H}			
b. Loss of more than 10 percent of surface area of a wall.	SF		
*** {Severity H}			
c. Extensive disintegration of surface area, with corrosion of exposed reinforcing steel.	SF		
*** {Severity H}			
<b>* Damaged brick, CMU or stone walls.</b>			
Observation:			
a. Cracked, split or damaged.	SF		
*** {Severity M}			
b. Loose or missing brick or stone.	SF		
*** {Severity H}			
<b>* Deteriorated mortar joint material.</b>			
Observation:			
a. Loose mortar joint material.	SF		
*** {Severity M}			
b. Missing mortar joint material.	SF		
*** {Severity H}			
<b>* Bowing or leaning concrete pit wall.</b>			
Observation:			
a. Wall out of alignment greater than 2" less than 3" per wall.	SF		
*** {Severity M}			
b. Wall out of alignment greater than 3" per wall.	SF		
*** {Severity H}			

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**07.04 STORM WATER COLLECTION SYSTEMS**

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**COMPONENTS (Continued)**

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**♦ 07.04.03 DRY WELLS (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Loose/missing cover/grate.</b>			
Observation:			
a. Loose cover or grate.	EA		
*** {Severity L}			
b. Missing or damaged cover or grate.	SF		
*** {Severity H}			
<b>* Dry well full of debris/sediment.</b>			
Observation:			
a. Debris/sediment within 2' of outlet.	CF		
*** {Severity M}			
b. Dry well full of debris/sediment	CF		
*** {Severity H}			

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**07.04 STORM WATER COLLECTION SYSTEMS**

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**REFERENCES**

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1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988
2. NAVFAC MO-322, Vol. II Inspection for Maintenance of Public Works & Public Utilities, 1993
3. American Water Works Association, Manual of Water Supply Practices, M-36, 1990
4. NAVFAC P-717.0, Department of Defense, Engineered Performance Standards for Real Property Maintenance Activities
5. Uniform Plumbing Code, International Association of Plumbing and Mechanical Officials, 1979
6. Constructing & Maintaining Your Well & Septic System, Max and Charlotte Alth, 1984, TAB Books Inc

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**07.04 STORM WATER COLLECTION SYSTEMS**

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**LEVEL II KEYS    GUIDE SHEET CONTROL NUMBER**

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N/A

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**LEVEL III KEYS    GUIDE SHEET CONTROL NUMBER**

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N/A



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## 07.05 COMPRESSED AIR SYSTEMS

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### DESCRIPTION

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Compressed Air Systems is a subsystem of the Building Plumbing System. The typical compressed air system consists of air pressurization, air drying and the distribution of compressed air to shop equipment controls and general utility outlets.

### SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

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No special tools are needed for the inspection of Compressed Air Systems, beyond the requirements listed in the Standard Tools Section.

### SPECIAL SAFETY REQUIREMENTS

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No special safety requirements are needed for the inspection of Compressed Air Systems, beyond the requirements listed in the Master Safety Plan and System Safety Section.

### COMPONENT LIST

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- ◆ 07.05.01 AIR COMPRESSORS - RECIPROCATING/SCROLL
- ◆ 07.05.02 MOTORS
- ◆ 07.05.03 DRIVE ASSEMBLIES
- ◆ 07.05.04 STORAGE TANKS
- ◆ 07.05.05 CONTROLS
- ◆ 07.05.06 FILTERS
- ◆ 07.05.07 AIR DRYERS - REFRIGERATED
- ◆ 07.05.08 AIR DRYERS - DESICCANT
- ◆ 07.05.09 PIPING, FITTINGS AND VALVES

### RELATED SUBSYSTEMS

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Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities.

07.06 VACUUM SYSTEMS - CLINIC/LABORATORY

## 07.05 COMPRESSED AIR SYSTEMS

### STANDARD INSPECTION PROCEDURE

This subsystem requires both Level I and Level II inspection as part of the basic inspection process. Additional Level II inspections may be indicated or "triggered" by the Level I inspection observation and should be accomplished by the inspector at that time. Associated defects and observations, for each major component, are listed in the Field CAIS.

The Facility Manager will authorize any Level III inspection he feels necessary for specialized compressor and motor applications.

### COMPONENTS

#### ♦ 07.05.01 AIR COMPRESSORS - RECIPROCATING/SCROLL

An air compressor is a mechanical device designed to provide and store compressed air for various uses. This sub-system consists of compressors capable of providing a maximum of 400 PSIG pressure. Single stage air compressors are frequently assembled as duplex units.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Damaged compressor.</b>			
Observation:			
a. Clogged or missing intake air filter.	EA		
*** {Severity M}			
b. Cracked/damaged compressor housing.	EA		
*** {Severity H}			
c. Oil leaking from compressor.	EA		
*** {Severity H}			
<b>* Excessive noise or vibration.</b>			
Observation:			
a. Rattling noise.	EA	1	1
*** {Severity M}			
b. Grinding noise, indicating metal to metal contact.	EA	1	1
*** {Severity H}			

## 07.05 COMPRESSED AIR SYSTEMS

### COMPONENTS (Continued)

#### ♦ 07.05.02 MOTORS

Electric motors are used to power or drive the air compressors.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Damaged motors.</b>			
Observation:			
a. Cracked/damaged housing or end bells.	EA		
*** {Severity H}			
b. Broken motor base.	EA		
*** {Severity H}			
<b>* Excessive noise or vibration.</b>			
Observation:			
a. Rattling noise.	EA	2	2
*** {Severity M}			
b. Grinding noise, indicating metal to metal contact.	EA	2	2
*** {Severity H}			
c. Electrical arcing noise.	EA		3
*** {Severity H}			
<b>* Defective electrical connectors.</b>			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity F}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity F}			

## 07.05 COMPRESSED AIR SYSTEMS

### COMPONENTS (Continued)

#### ♦ 07.05.03 DRIVE ASSEMBLIES

The drive assembly connects the air compressor to the motor. The assembly consists of V-drive belts and pulleys or flexible couplings and safety guards.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Defective drive assembly.</b>			
Observation:			
a. Loose belt.	EA		
*** {Severity M}			
b. Loose coupling/pulley set screws.	EA		
*** {Severity M}			
c. Broken/missing belt.	EA		
*** {Severity H}			
d. Missing pulley set screws.	EA		
*** {Severity H}			
e. Broken/missing couplings.	EA		
*** {Severity H}			
<b>* Loose/missing belt/coupling guard.</b>			
Observation:			
a. Loose belt/coupling guard.	EA		
*** {Severity M}			
b. Missing belt/coupling guard.	EA		
*** {Severity H}			

## 07.05 COMPRESSED AIR SYSTEMS

### COMPONENTS (Continued)

#### ♦ 07.05.04 STORAGE TANKS

Storage tanks provide reserve capacity in the compressed air system, allowing for demand fluctuations.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Physical damage.</b>			
Observation:			
a. Abrasions.	SF		
*** {Severity L}			
b. Physical damage, dents.	SF		
*** {Severity M}			
<b>* Leaking tank, piping, fittings and valves.</b>			
Observation:			
a. Leaking valve packing glands/seals, evidenced by leaking air.	EA		
*** {Severity M}			
b. Damaged piping, fittings, or valves.	EA		
*** {Severity H}			
c. Stress cracks in tank, evidence by leaking air.	EA		
*** {Severity H}			
<b>* Loose/missing mounting hardware.</b>			
Observation:			
a. Loose base tie-down bolts.	EA		
*** {Severity M}			
b. Missing base tie-down bolts or isolators.	EA		
*** {Severity H}			
<b>* Defective pressure gauges.</b>			
Observation:			
a. Broken gauge or gauge lens.	EA		
*** {Severity L}			
b. Leaking pressure gauge.	EA		
*** {Severity M}			

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**07.05 COMPRESSED AIR SYSTEMS**

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**COMPONENTS (Continued)**

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**♦ 07.05.04 STORAGE TANKS (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Corrosion.</b>			
Observation:			
a. Surface corrosion no pitting evident.	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	SF		
*** {Severity H}			
<b>* Missing/expired certification.</b>			
Observation:			
a. Missing/expired certification, more than (2) years since last certification.	EA		
*** {Severity S}			

## 07.05 COMPRESSED AIR SYSTEMS

### COMPONENTS (Continued)

#### ♦ 07.05.05                      CONTROLS

Controls govern the operation of the motor and consist of switches, starters, controllers and disconnects.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Physically damaged control panel.</b>			
Observation:			
a. Control panel blocked, not accessible for inspection.	EA		
*** {Severity S}			
b. Physically damaged control panel enclosure.	EA		
*** {Severity M}			
c. Burned out pilot lamps.	EA		
*** {Severity F}			
<b>* Corrosion.</b>			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			

## 07.05 COMPRESSED AIR SYSTEMS

### COMPONENTS (Continued)

#### ♦ 07.05.06            FILTERS

Filters are installed in the distribution line to remove particulate matter from the air.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Defective or missing filter.</b>			
Observation:			
a. Loose, damaged, or missing mount fasteners.	EA		
*** {Severity M}			
b. Dirty or saturated filter.	EA		
*** {Severity M}			
c. Filter leaking air.	EA		
*** {Severity H}			
d. Missing filter.	EA		
*** {Severity H}			
<b>* Corrosion.</b>			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			



## 07.05 COMPRESSED AIR SYSTEMS

### COMPONENTS (Continued)

#### ♦ 07.05.07 AIR DRYERS - REFRIGERATED

Dryers are installed in the distribution line to remove oil and moisture from the air. The most common dryer is a small refrigerated unit employing a hermetically sealed compressor, a shell and tube evaporator and fan-cooled condenser.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Defective or missing dryer.</b>			
Observation:			
a. Loose electrical dryer connections.	EA		
*** {Severity L}			
b. Loose, damaged, missing mount fasteners.	EA		
*** {Severity M}			
c. Malfunctioning compressor.	EA		
*** {Severity H}			
d. Malfunctioning evaporator.	EA		
*** {Severity H}			
e. Malfunctioning fan.	EA		
*** {Severity H}			
f. Dryer leaking air.	EA		
*** {Severity H}			
g. Disconnected dryer.	EA		
*** {Severity H}			
<b>* Corrosion.</b>			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			

## 07.05 COMPRESSED AIR SYSTEMS

### COMPONENTS (Continued)

#### ♦ 07.05.08 AIR DRYERS - DESICCANT

Dryers are installed in the distribution line to remove oil and moisture from the air. An alternative to the refrigerated dryer uses a desiccant or drying agent such as silica gel. In small units, the desiccant is periodically replaced. In larger units, dryers are installed in parallel with controls to alternate the dryer in use (automated). The desiccant of the "off-line" dryer is regenerated using a heating mechanism.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Defective or missing dryer.</b>			
Observation:			
a. Loose electrical dryer connections.	EA		
*** {Severity L}			
b. Saturated dryer desiccant.	EA		
*** {Severity M}			
c. Loose, damaged, missing mount fasteners.	EA		
*** {Severity M}			
d. Missing dryer.	EA		
*** {Severity H}			
e. Malfunctioning automated dryer.	EA		
*** {Severity H}			
<b>* Corrosion.</b>			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			

## 07.05 COMPRESSED AIR SYSTEMS

### COMPONENTS (Continued)

#### ♦ 07.05.09 PIPING, FITTINGS AND VALVES

Piping and fittings provide the distribution network for the compressed air system.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Leaking/damaged fitting.</b>			
Observation:			
a. Bent or cracked fitting, not leaking.	EA		
*** {Severity L}			
b. Air leaking.	EA		
*** {Severity H}			
<b>* Leaking/damaged pipe.</b>			
Observation:			
a. Bent or cracked pipe, not leaking.	LF		
*** {Severity L}			
b. Air leaking.	LF		
*** {Severity H}			
<b>* Leaking/damaged valves.</b>			
Observation:			
a. Broken or missing valve handle.	EA		
*** {Severity L}			
b. Bent stem.	EA		
*** {Severity M}			
c. Leaking valve packing glands/gaskets.	EA		
*** {Severity M}			
d. Cracked valve body.	EA		
*** {Severity H}			
<b>* Loose/missing supports/hangers.</b>			
Observation:			
a. Loose supports or hangers.	EA		
*** {Severity L}			
b. Broken or missing supports or hangers.	EA		
*** {Severity H}			

## 07.05 COMPRESSED AIR SYSTEMS

### COMPONENTS (Continued)

#### ♦ 07.05.09 PIPING, FITTINGS AND VALVES (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Corroded piping and fittings.</b>			
Observation:			
a. Surface corrosion no pitting evident.	LF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	LF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	LF		
*** {Severity H}			
<b>* Corroded hangers or supports.</b>			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			
<b>* Defective pipe labeling/color coding.</b>			
Observation:			
a. Damaged or missing labels.	EA		
*** {Severity F}			
b. Damaged or missing color coding.	LF		
*** {Severity F}			

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**07.05 COMPRESSED AIR SYSTEMS**

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**REFERENCES**

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1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988
2. NAVFAC MO-322, Vol. II Inspection for Maintenance of Public Works & Public Utilities, 1993
3. NAVFAC P-717.0, Department of Defense, Engineered Performance Standards for Real Property Maintenance Activities
4. Uniform Plumbing Code, International Association of Plumbing and Mechanical Officials, 1979
5. NAVFAC MO-206, Maintenance and Operation of Air Compressor Plants, 1989
6. NAVFAC MO-209, Maintenance of Steam, Hot Water and Compressed Air Distribution Systems, 1989
7. NAVFAC MO-324, Inspection and Certification of Boilers and Unfired Pressure Vessels, 1992

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**07.05 COMPRESSED AIR SYSTEMS**

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**LEVEL II KEY      GUIDE SHEET CONTROL NUMBER**

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1	GS-II 07.05.01-1
2	GS-II 07.05.02-2

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**LEVEL III KEY      GUIDE SHEET CONTROL NUMBER**

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1	GS-III 07.05.01-1
2	GS-III 07.05.02-2
3	GS-III 07.05.02-3

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**LEVEL II INSPECTION METHOD GUIDE SHEET**

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**LEVEL II GUIDE SHEET - KEY NO. 1**

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**COMPONENT:** AIR COMPRESSORS - RECIPROCATING/SCROLL  
**CONTROL NUMBER:** GS-II 07.05.01-1

**Application**

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the compressor, if 100 CFM or greater in size.

**Special Safety Requirements**

No special safety requirements are needed for the performance of the Level II inspection beyond those required in the Master Safety Plan and System Safety Section.

**Inspection Actions**

1. Observe operation of compressor. Note start-up and shut-off pressures and the associated time interval.
2. Note any unusual noise or vibration in the compressor.
3. Note any leakage in compressor.
4. Inspect compressor housing for stress cracks, corrosion, other physical damage.
5. Check compressor mounts for loose, damaged, missing fasteners.
6. Check pipe fittings at compressor connection for stress, leakage.
7. Check intake filter for dirt infiltration.
8. Note condition of lubrication: burned oil, inadequate level, high contamination level.
9. Check drive components (coupling, belts, sheaves) for wear, damage, loose fasteners.
10. Check drive for misalignment.
11. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
12. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.

**Recommended Inspection Frequency**

Perform inspection when triggered by a Level I inspection or other local factors such as problematic conditions.

**References**

1. NAVFAC MO-206, Maintenance and Operation of Air Compressor Plants, 1989
2. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

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**LEVEL II INSPECTION METHOD GUIDE SHEET**

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**LEVEL II GUIDE SHEET - KEY NO. 2**

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**COMPONENT:** MOTORS  
**CONTROL NUMBER:** GS-II 07.05.02-2

**Application**

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the motor, if 60 HP or greater in size.

**Special Safety Requirements**

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

**Inspection Actions**

1. Observe motor operation and determine possible source of noise.
2. Shut down motor, tag and lock out disconnect.
3. Check coupling for wear, damage or loose fasteners.
4. Visually check interior of motor housing for other physical damage, if an open motor.
5. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
6. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
7. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

**Recommended Inspection Frequency**

Perform inspection when triggered by a Level I or other local factors such as problematic conditions.

**References**

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988.



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**LEVEL III INSPECTION METHOD GUIDE SHEET**

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**LEVEL III GUIDE SHEET - KEY NO. 1**

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**COMPONENT:** AIR COMPRESSOR - RECIPROCATING/SCROLL**CONTROL NUMBER:** GS-III 07.05.01-1**Application**

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the compressor, if 100 CFM or greater in size.

**Special Safety Requirements**

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.
2. Always have one person standing outside when someone is working inside a confined area.

**Inspection Actions****Prior to Shutdown:**

1. Observe operation of compressor. Note start-up and shut-off pressures and the associated time interval.
2. Perform vibration analysis of compressor.
3. Check compressor RPM with tachometer or stroboscope: compare with manufacturer's specifications.
4. Shut off the compressor.
5. Isolate storage tank from system service.
6. Drain storage tank to ambient pressure.
7. Start compressor and record time required to reach shut-off pressure. Compare to compressor's rated capacity.
8. Draw an oil sample for chemical analysis.

**Unit Shutdown:**

9. Turn off unit and lock out disconnect.
10. Tag out all electrical devices.
11. Isolate unit mechanically.
12. Tag out all secured valves.
13. Open and inspect compressor.
14. Check cylinder walls (housing) for cracks, fatigue, wear and corrosion. Check suspicious areas with dye penetrant.
15. Check pistons for wear, corrosion and physical damage.
16. Check piston rings for wear, cracking and breaks.
17. Check suction and discharge valves for wear and fatigue.
18. Check valve springs for signs of fatigue.

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**LEVEL III INSPECTION METHOD GUIDE SHEET**

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**LEVEL III GUIDE SHEET - KEY NO. 1 (Continued)**

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**COMPONENT:** AIR COMPRESSOR - RECIPROCATING/SCROLL**CONTROL NUMBER:** GS-III 07.05.01-1**Inspection Actions (Continued)****Shutdown Inspection:**

19. Check piston pins, rods and rod bearings for wear, fatigue, and loose fasteners. Dye check stress areas.
20. Rotate shafting and check for distortion in shaft.
21. Check ring clearances: compare with manufacturer's specifications.
22. Reassemble compressor.
23. Rotate compressor shaft and check for binding, rubbing in compressor.
24. Measure runout play in bearings due to wear; compare with manufacturer's specifications.
25. Check intake filter housing for dirt infiltration.

**Return to Service:**

26. Ensure that all tools, equipment and materials used for inspection have been removed from the unit.
27. Ensure that all guards and covers have been reinstalled.
28. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
29. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
30. Restore valves to their normal position.
31. Restore pressure in storage tank to normal.
32. Ensure all guards and covers have been reinstalled; remove tags, lockout on disconnect and restore unit to service.

**Special Tools and Equipment**

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Alignment tools
2. Vibration tester
3. Infrared temperature tester
4. Dye penetrant
5. Tachometer or stroboscope

**Recommended Inspection Frequency**

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

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**LEVEL III INSPECTION METHOD GUIDE SHEET**

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**LEVEL III GUIDE SHEET - KEY NO. 1 (Continued)**

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**COMPONENT:** AIR COMPRESSOR - RECIPROCATING/SCROLL  
**CONTROL NUMBER:** GS-III 07.05.01-1

**References**

1. NAVFAC MO-206, Maintenance and Operation of Air Compressor Plants, 1989
2. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

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**LEVEL III INSPECTION METHOD GUIDE SHEET**

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**LEVEL III GUIDE SHEET - KEY NO. 2**

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**COMPONENT:** MOTORS  
**CONTROL NUMBER:** GS-III 07.05.02-2

**Application**

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the motor, if 60 HP or greater in size.

**Special Safety Requirements**

The following is a list of special requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.
2. Always have one person standing outside when someone is working inside a confined area.

**Inspection Actions**

1. Observe motor operation and determine possible source of noise.
2. Perform vibration analysis on motor bearings.
3. Shut down motor, tag and lock out disconnect.
4. Rotate (cycle) motor to check for binding.
5. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
6. Open and inspect motor interior housing for cracks, fatigue, erosion and corrosion, check suspicious areas with dye penetrant.
7. Check interior shafting for signs of fatigue or wear.
8. Rotate (cycle) shafting and check for distortion.
9. Document the problem and contact appropriate facility personnel for further instructions and reassemble motor, if directed.
10. Notify appropriate personnel for permission to place unit back in service if defect is not critical to continued function.
11. Ensure all guards and covers have been reinstalled; remove tags, lockout on disconnect and restore unit to service.

**Special Tools and Equipment**

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Alignment Tools
2. Vibration Tester
3. Dye Penetrant

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**LEVEL III INSPECTION METHOD GUIDE SHEET**

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**LEVEL III GUIDE SHEET - KEY NO. 2 (Continued)**

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**COMPONENT:** MOTORS  
**CONTROL NUMBER:** GS-III 07.05.02-2

**Recommended Inspection Frequency**

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

**References**

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988
2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

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**LEVEL III INSPECTION METHOD GUIDE SHEET**

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**LEVEL III GUIDE SHEET - KEY NO. 3**

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**COMPONENT:** MOTORS  
**CONTROL NUMBER:** GS-III 07.05.02-3

**Application**

This guide applies to the investigation of electrical arcing noise from the motor, if 60 HP or greater in size.

**Special Safety Requirements**

The following is a list of special requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.
2. Always have one person standing outside when someone is working inside a confined area.

**Inspection Actions**

1. Observe motor operation and determine possible source of noise.
2. Check voltage at motor and current draw. Compare to motor ratings and the requirements of the associated equipment.
3. Perform vibration analysis on the motor.
4. Rotate motor shaft and check for binding, rubbing.
5. Measure run-out play in bearings due to wear; compare with manufacturer's specification.
6. Check alignment.
7. Shut down motor and lock out disconnect.
8. Open motor and inspect interior housing for stress cracks, corrosion, other physical damage, check suspicious areas with dye penetrant.
9. Check stator windings for dirt, moisture, physical damage, signs of overheating, loose fasteners.
10. Check rotor windings for dirt, moisture, physical damage, signs of overheating, loose fasteners.
11. Check commutator/slip rings for loose parts, physical damage, wear.
12. Check brushes for wear, proper tension.
13. Check bearings for lube leakage into motor.
14. Check motor shafting for wear.
15. Document the problem and contact appropriate facility personnel for further instructions and reassemble motor, if directed.
16. Notify appropriate personnel for permission to place unit back in service if defect is not critical to continued function.
17. Ensure all guards and covers have been reinstalled; remove tags, lockout on disconnect and restore unit to service.

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**LEVEL III INSPECTION METHOD GUIDE SHEET**

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**LEVEL III GUIDE SHEET - KEY NO. 3 (Continued)**

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**COMPONENT:** MOTORS  
**CONTROL NUMBER:** GS-III 07.05.02-3

**Special Tools and Equipment**

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Alignment Tools
2. Vibration Tester
3. Infrared Temperature Tester
4. Ammeter
5. Voltmeter
6. Dye Penetrant

**Recommended Inspection Frequency**

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

**References**

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988
2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

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**07.06 VACUUM SYSTEMS - CLINIC/LABORATORY/SHOP**

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**DESCRIPTION**

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Vacuum Systems - Clinic/Laboratory/Shop is a subsystem of the Building Plumbing System., Vacuum systems are normally found in facilities that require up to 28" of vacuum.

**SPECIAL TOOL AND EQUIPMENT REQUIREMENTS**

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No special tools are needed for the inspection of Vacuum Systems, beyond the requirements listed in the Standard Tools Section.

**SPECIAL SAFETY REQUIREMENTS**

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No special safety requirements are needed for the inspection of Vacuum Systems, beyond the requirements listed in the Master Safety Plan and System Safety Section.

**COMPONENT LIST**

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- ◆ 07.06.01 VACUUM PUMPS - RECIPROCATING/ROTARY VANE
- ◆ 07.06.02 MOTORS
- ◆ 07.06.03 DRIVE ASSEMBLIES
- ◆ 07.06.04 HOLDING TANKS
- ◆ 07.06.05 CONTROLS
- ◆ 07.06.06 PIPING, FITTINGS AND VALVES

**RELATED SUBSYSTEMS**

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Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities:

07.05 COMPRESSED AIR SYSTEMS



## 07.06 VACUUM SYSTEMS - CLINIC/LABORATORY/SHOP

### STANDARD INSPECTION PROCEDURE

This subsystem requires both Level I and Level II inspection as part of the basic inspection process. Additional Level II inspections may be indicated or "triggered" by the Level I inspection observation and should be accomplished by the inspector at that time. Associated defects and observations, for each major component, are listed in the Field CAIS.

The Facility Manager will authorize any Level III inspection he feels necessary for specialized pump and motor applications.

### COMPONENTS

#### ♦ 07.06.01 VACUUM PUMPS - RECIPROCATING/ROTARY VANE

A vacuum pump is a mechanical device designed to create a vacuum up to 28". Single stage reciprocating vacuum pumps are frequently assembled as duplex units.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Damaged vacuum pumps.			
Observation:			
a. Cracked/damaged vacuum pump housing.	EA		
*** {Severity H}			
b. Oil leaking from vacuum pump.	EA		
*** {Severity H}			
* Excessive noise or vibration.			
Observation:			
a. Rattling noise.	EA	1	1
*** {Severity M}			
b. Grinding noise, indicating metal to metal contact.	EA	1	1
*** {Severity H}			

## 07.06 VACUUM SYSTEMS - CLINIC/LABORATORY/SHOP

### COMPONENTS (Continued)

#### ♦ 07.06.02 MOTORS

Electric motors are used to power or drive the vacuum pumps.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Damaged motors.</b>			
Observation:			
a. Cracked/damaged housing or end bells.	EA		
*** {Severity H}			
b. Broken motor base.	EA		
*** {Severity H}			
<b>* Excessive noise or vibration.</b>			
Observation:			
a. Rattling noise.	EA	2	2
*** {Severity M}			
b. Grinding noise, indicating metal to metal contact.	EA	2	2
*** {Severity H}			
c. Electrical arcing noise.	EA		3
*** {Severity H}			
<b>* Defective electrical connectors.</b>			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity F}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity F}			

## 07.06 VACUUM SYSTEMS - CLINIC/LABORATORY/SHOP

### COMPONENTS (Continued)

#### ♦ 07.06.03 DRIVE ASSEMBLIES

The drive assembly connects the vacuum pump to the motor. The assembly consists of V-drive belts and pulleys or flexible couplings and safety guards.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Defective drive assembly.</b>			
Observation:			
a. Loose belt.	EA		
*** {Severity M}			
b. Loose coupling/pulley set screws.	EA		
*** {Severity M}			
c. Missing pulley set screws.	EA		
*** {Severity M}			
d. Broken/missing belt.	EA		
*** {Severity H}			
e. Broken/missing couplings.	EA		
*** {Severity H}			
<b>* Loose/missing belt/coupling guard.</b>			
Observation:			
a. Loose belt guard.	EA		
*** {Severity M}			
b. Missing belt guard.	EA		
*** {Severity H}			

## 07.06 VACUUM SYSTEMS - CLINIC/LABORATORY/SHOP

### COMPONENTS (Continued)

#### ♦ 07.06.04            HOLDING TANKS

Holding tanks provide reserve capacity in the vacuum system, allowing for demand fluctuations.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Physical damage.</b>			
Observation:			
a. Abrasions.	SF		
*** {Severity L}			
b. Physical damage, dents.	SF		
*** {Severity M}			
<b>* Leaking tank, piping, fittings and valves.</b>			
Observation:			
a. Leaking valve packing glands/seals, evidenced by leaking air.	EA		
*** {Severity M}			
b. Damaged piping, fittings, or valves.	EA		
*** {Severity H}			
c. Stress cracks in tank, evidenced by leaking air.	EA		
*** {Severity H}			
<b>* Loose/missing mounting hardware.</b>			
Observation:			
a. Loose base tie-down bolts.	EA		
*** {Severity M}			
b. Missing base tie-down bolts or isolators.	EA		
*** {Severity H}			
<b>* Defective pressure gauges.</b>			
Observation:			
a. Broken gauge or gauge lens.	EA		
*** {Severity L}			
b. Leaking pressure gauge.	EA		
*** {Severity M}			

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**07.06 VACUUM SYSTEMS - CLINIC/LABORATORY/SHOP**

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**COMPONENTS (Continued)**

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**◆ 07.06.04            HOLDING TANKS (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Corrosion.</b>			
Observation:			
a. Surface corrosion no pitting evident.	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	SF		
*** {Severity H}			
<b>* Missing/expired certification.</b>			
Observation:			
a. Missing/expired certification, more than (2) years since last certification.	EA		
*** {Severity S}			

## 07.06 VACUUM SYSTEMS - CLINIC/LABORATORY/SHOP

### COMPONENTS (Continued)

#### ♦ 07.06.05                      CONTROLS

Controls govern the operation of the motor and consist of switches, starters, controllers and disconnects.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Physically damaged control panel.</b>			
Observation:			
a.   Control panel blocked, not accessible for inspection.	EA		
*** {Severity S}			
b.   Physically damaged control panel enclosure.	EA		
*** {Severity M}			
c.   Burned out pilot lamps.	EA		
*** {Severity F}			
<b>* Corrosion.</b>			
Observation:			
a.   Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b.   Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c.   Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			

## 07.06 VACUUM SYSTEMS - CLINIC/LABORATORY/SHOP

### COMPONENTS (Continued)

#### ♦ 07.06.06 PIPING, FITTINGS AND VALVES

Piping and fittings provide the distribution network for the vacuum system.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Leaking/damaged fitting.</b>			
Observation:			
a. Bent or cracked fitting, not leaking.	EA		
*** {Severity L}			
b. Air leaking.	EA		
*** {Severity H}			
<b>* Leaking/damaged pipe.</b>			
Observation:			
a. Bent or cracked pipe, not leaking.	LF		
*** {Severity L}			
b. Air leaking.	LF		
*** {Severity H}			
<b>* Leaking/damaged valves.</b>			
Observation:			
a. Broken or missing valve handle.	EA		
*** {Severity L}			
b. Bent stem.	EA		
*** {Severity M}			
c. Leaking valve packing glands/gaskets.	EA		
*** {Severity M}			
d. Cracked valve body.	EA		
*** {Severity H}			
<b>* Loose/missing supports/hangers.</b>			
Observation:			
a. Loose supports or hangers.	EA		
*** {Severity L}			
b. Broken or missing supports or hangers.	EA		
*** {Severity H}			

## 07.06 VACUUM SYSTEMS - CLINIC/LABORATORY/SHOP

### COMPONENTS (Continued)

#### ♦ 07.06.06 PIPING, FITTINGS AND VALVES (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Corroded piping and fittings.</b>			
Observation:			
a. Surface corrosion no pitting evident.	LF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	LF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	LF		
*** {Severity H}			
<b>* Corroded hangers or supports.</b>			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			
<b>* Defective pipe labeling/color coding.</b>			
Observation:			
a. Damaged or missing labels.	EA		
*** {Severity F}			
b. Damaged or missing color coding.	LF		
*** {Severity F}			



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**07.06 VACUUM SYSTEMS - CLINIC/LABORATORY/SHOP**

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**REFERENCES**

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1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988
2. NAVFAC MO-322, Vol. II Inspection for Maintenance of Public Works & Public Utilities, 1993
3. NAVFAC P-717.0, Department of Defense, Engineered Performance Standards for Real Property Maintenance Activities
4. Uniform Plumbing Code, International Association of Plumbing and Mechanical Officials, 1979
5. NAVFAC MO-206, Maintenance and Operation of Air Compressor Plants, 1989
6. NAVFAC MO-209, Maintenance of Steam, Hot Water and Compressed Air Distribution Systems, 1989
7. NAVFAC MO-324, Inspection and Certification of Boilers and Unfired Pressure Vessels, 1992
8. Grainger, Industrial and Commercial Equipment and Supplies Catalog
9. McMaster-Carr Supply Company Catalog
10. Means Mechanical Cost Data

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**07.06 VACUUM SYSTEMS - CLINIC/LABORATORY/SHOP**

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**LEVEL II KEY                      GUIDE SHEET CONTROL NUMBER**

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1	GS-II 07.06.01-1
2	GS-II 07.06.02-2

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**LEVEL III KEY                      GUIDE SHEET CONTROL NUMBER**

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1	GS-III 07.06.01-1
2	GS-III 07.06.02-2
3	GS-III 07.06.02-3

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**LEVEL II INSPECTION METHOD GUIDE SHEET**

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**LEVEL II GUIDE SHEET - KEY NO. 1**

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**COMPONENT:** VACUUM PUMPS - RECIPROCATING/ROTARY VANE  
**CONTROL NUMBER:** GS-II 07.06.01-1

**Application**

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the vacuum pump, if 50 CFM or greater in size.

**Special Safety Requirements**

No special safety requirements, beyond the requirements listed in the Introduction Safety Section, are needed for the performance of this inspection.

**Inspection Actions**

1. Observe operation of pump. Note start-up and shut-off pressures and the associated time interval.
2. Note any unusual noise or vibration in the pump.
3. Note any leakage in pump.
4. Inspect pump housing for stress cracks, corrosion, other physical damage.
5. Check pump mounts for loose, damaged, missing fasteners.
6. Check pipe fittings at pump connection for stress, leakage.
7. Note condition of lubrication: burned oil, inadequate level, high contamination level.
8. Check drive components (coupling, belts, sheaves) for wear, damage, loose fasteners.
9. Check drive for misalignment.
10. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
11. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.

**Recommended Inspection Frequency**

Perform inspection when triggered by a Level I inspection or other local factors such as problematic conditions.

**References**

1. NAVFAC MO-206, Maintenance and Operation of Air Compressor Plants, 1989
2. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

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**LEVEL II INSPECTION METHOD GUIDE SHEET**

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**LEVEL II GUIDE SHEET - KEY NO. 2**

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**COMPONENT:** MOTORS  
**CONTROL NUMBER:** GS-II 07.06.02-2

**Application**

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the motor, if 60 HP or greater in size.

**Special Safety Requirements**

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

**Inspection Actions**

1. Observe motor operation and determine possible source of noise.
2. Shut down motor, tag and lock out disconnect.
3. Check coupling for wear, damage or loose fasteners.
4. Visually check interior of motor housing for other physical damage, if an open motor.
5. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
6. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
7. Ensure all guards and covers have been reinstalled; remove tags, lockout on disconnect and restore unit to service.

**Recommended Inspection Frequency**

Perform inspection when triggered by a Level I or other local factors such as problematic conditions.

**References**

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988.

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**LEVEL III INSPECTION METHOD GUIDE SHEET**

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**LEVEL III GUIDE SHEET - KEY NO. 1**

---

**COMPONENT:** VACUUM PUMPS - RECIPROCATING/ROTARY VANE**CONTROL NUMBER:** GS-III 07.06.01-1**Application**

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the vacuum pump, if 50 CFM or greater in size.

**Special Safety Requirements**

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

**Inspection Actions****Prior to Shutdown:**

1. Observe operation of vacuum pump. Note start-up and shut-off pressures and the associated time interval.
2. Perform vibration analysis of pump.
3. Check pump RPM with tachometer or stroboscope: compare with manufacturer's specifications.
4. Shut off the pump.
5. Isolate holding tank from system service.
6. Open holding tank to ambient pressure.
7. Start pump and record time required to reach shut-off pressure. Compare to pump's rated capacity.
8. Draw an oil sample for chemical analysis.

**Unit Shutdown:**

9. Turn off unit and lock out disconnect.
10. Tag out all electrical devices.
11. Isolate unit mechanically.
12. Tag out all secured valves.
13. Open and inspect pump.
14. Check cylinder walls (housing) for cracks, fatigue, wear and corrosion. Check suspicious areas with dye penetrant.
15. Check pistons/vanes for wear, corrosion and physical damage.
16. Check piston rings for wear, cracking and breaks (reciprocating pumps only).
17. Check suction and discharge valves for wear and fatigue.
18. Check valve springs for signs of fatigue.

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**LEVEL III INSPECTION METHOD GUIDE SHEET**

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**LEVEL III GUIDE SHEET - KEY NO. 1 (Continued)**

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**COMPONENT:** VACUUM PUMPS - RECIPROCATING/ROTARY VANE  
**CONTROL NUMBER:** GS-III 07.06.01-1

**Inspection Actions (Continued)****Shutdown Inspection:**

19. Check piston pins, rods and rod bearings for wear, fatigue, and loose fasteners. Dye check stress areas (reciprocating pumps only).
20. Rotate shafting and check for distortion in shaft.
21. Check ring/vane clearances: compare with manufacturer's specifications.
22. Reassemble pump.
23. Rotate pump shaft and check for binding, rubbing in compressor.
24. Measure runout play in bearings due to wear; compare with manufacturer's specifications.
25. Check intake filter housing for dirt infiltration.

**Return to Service:**

26. Ensure that all tools, equipment and materials used for inspection have been removed from the unit.
27. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
28. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
29. Restore valves to normal position.
30. Ensure all guards and covers have been reinstalled; remove tags, lockout on disconnect and restore unit to service.

**Special Tools and Equipment**

The following special tools and equipment, beyond the requirements listed in the Standard Tool Section, are required to perform this inspection.

1. Alignment tools
2. Vibration tester
3. Infrared temperature tester
4. Dye penetrant
5. Tachometer or stroboscope

**Recommended Inspection Frequency**

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

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**LEVEL III INSPECTION METHOD GUIDE SHEET**

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**LEVEL III GUIDE SHEET - KEY NO. 1 (Continued)**

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**COMPONENT:** VACUUM PUMPS - RECIPROCATING/ROTARY VANE

**CONTROL NUMBER:** GS-III 07.06.01-1

**References**

1. NAVFAC MO-206, Maintenance and Operation of Air Compressor Plants, 1989
2. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

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**LEVEL III INSPECTION METHOD GUIDE SHEET**

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**LEVEL III GUIDE SHEET - KEY NO. 2**

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**COMPONENT:** MOTORS  
**CONTROL NUMBER:** GS-III 07.06.02-2

**Application**

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the motor, if 60 HP or greater in size.

**Special Safety Requirements**

The following is a list of special requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

**Inspection Actions**

1. Observe motor operation and determine possible source of noise.
2. Perform vibration analysis on motor bearings.
3. Shut down motor, tag and lock out disconnect.
4. Rotate (cycle) motor to check for binding.
5. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
6. Open and inspect motor interior housing for cracks, fatigue, erosion and corrosion, check suspicious areas with dye penetrant.
7. Check interior shafting for signs of fatigue or wear.
8. Rotate (cycle) shafting and check for distortion.
9. Document the problem and contact appropriate facility personnel for further instructions and reassemble motor, if directed.
10. Notify appropriate personnel for permission to place unit back in service if defect is not critical to continued function.
11. Ensure all guards and covers have been reinstalled; remove tags, lockout on disconnect and restore unit to service.

**Special Tools and Equipment**

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Alignment Tools
2. Vibration Tester
3. Dye Penetrant



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**LEVEL III INSPECTION METHOD GUIDE SHEET**

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**LEVEL III GUIDE SHEET - KEY NO. 2 (Continued)**

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**COMPONENT:** MOTORS  
**CONTROL NUMBER:** GS-III 07.06.02-2

**Recommended Inspection Frequency**

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

**References**

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988
2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

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**LEVEL III INSPECTION METHOD GUIDE SHEET**

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**LEVEL III GUIDE SHEET - KEY NO. 3**

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**COMPONENT:** MOTORS  
**CONTROL NUMBER:** GS-III 07.06.02-3

**Application**

This guide applies to the investigation of electrical arcing noise from the motor, if 60 HP or greater in size.

**Special Safety Requirements**

The following is a list of special requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

**Inspection Actions**

1. Observe motor operation and determine possible source of noise.
2. Check voltage at motor and current draw. Compare to motor ratings and the requirements of the associated equipment.
3. Perform vibration analysis on the motor.
4. Rotate motor shaft and check for binding, rubbing.
5. Measure run-out play in bearings due to wear; compare with manufacturer's specification.
6. Check alignment.
7. Shut down motor and lock out disconnect.
8. Open motor and inspect interior housing for stress cracks, corrosion, other physical damage, check suspicious areas with dye penetrant.
9. Check stator windings for dirt, moisture, physical damage, signs of overheating, loose fasteners.
10. Check rotor windings for dirt, moisture, physical damage, signs of overheating, loose fasteners.
11. Check commutator/slip rings for loose parts, physical damage, wear.
12. Check brushes for wear, proper tension.
13. Check bearings for lube leakage into motor.
14. Check motor shafting for wear.
15. Document the problem and contact appropriate facility personnel for further instructions and reassemble motor, if directed.
16. Notify appropriate personnel for permission to place unit back in service if defect is not critical to continued function.
17. Ensure all guards and covers have been reinstalled; remove tags, lockout on disconnect and restore unit to service.

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**LEVEL III INSPECTION METHOD GUIDE SHEET**

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**LEVEL III GUIDE SHEET - KEY NO. 3 (Continued)**

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**COMPONENT:** MOTORS  
**CONTROL NUMBER:** GS-III 07.06.02-3

**Special Tools and Equipment**

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Alignment Tools
2. Vibration Tester
3. Infrared Temperature Tester
4. Ammeter
5. Voltmeter
6. Dye Penetrant

**Recommended Inspection Frequency**

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

**References**

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988
2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

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## 07.07 MEDICAL GAS SYSTEMS

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### DESCRIPTION

Medical Gas Systems are a subsystem of the Building Plumbing System. Oxygen, Nitrogen and Nitrous Oxide are referred to as medical gases. They are stored in pressurized cylinders and tanks and conveyed through a system of pipes to controlling units throughout the facility. The piping, valves and connectors are color coded as follows:

- |                  |       |
|------------------|-------|
| 1. Oxygen        | Green |
| 2. Nitrous Oxide | Blue  |
| 3. Nitrogen      | Black |

It is essential that this color code is in place and intact throughout the system.

### SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

No special tools are needed for the inspection of Medical Gas Systems, beyond the requirements listed in the Standard Tools Section.

### SPECIAL SAFETY REQUIREMENTS

No special safety requirements are needed for the inspection of Medical Gas Systems, beyond the requirements listed in the Master Safety Plan and System Safety Section.

### COMPONENT LIST

- ◆ 07.07.01 STORAGE CYLINDERS/TANKS
- ◆ 07.07.02 GAS DISTRIBUTION NETWORK
- ◆ 07.07.03 ALARMS

### RELATED SUBSYSTEMS

There are no subsystems that are related in nature to the elements requiring inspection.

## 07.07 MEDICAL GAS SYSTEMS

### STANDARD INSPECTION PROCEDURE

This subsystem requires a Level I inspection as part of the basic inspection process. Associated defects and observations, for each major component, are listed in the Field CAIS.

### COMPONENTS

#### ♦ 07.07.01 STORAGE CYLINDERS/TANKS

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Mismatched cylinders.</b>			
Observation:			
a. Missing cylinder nameplates.	EA		
*** {Severity F}			
b. Mismatched cylinder, not interchangeable.	EA		
*** {Severity H}			
c. Damaged mounting brackets.	EA		
*** {Severity H}			
<b>* Defective cylinder manifolds.</b>			
Observation:			
a. Inaccessible manifold, hoses or control heads.	EA		
*** {Severity S}			
b. Missing cylinder, control head open.	EA		
*** {Severity H}			
c. Physically damaged manifold, hoses or control head.	EA		
*** {Severity H}			
<b>* Defective electrical connections.</b>			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity F}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity F}			

## 07.07 MEDICAL GAS SYSTEMS

### COMPONENTS (Continued)

#### ♦ 07.07.01 STORAGE CYLINDERS/TANKS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Corrosion of cylinders.</b>			
Observation:			
a. Surface corrosion no pitting evident.	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	SF		
*** {Severity H}			
<b>* Defective labeling.</b>			
Observation:			
a. Nitrous oxide and oxygen gauges not labeled "do not oil".	EA		
*** {Severity S}			
b. Damaged or missing labels.	EA		
*** {Severity F}			
c. Damaged or missing color coding.	LF		
*** {Severity F}			
<b>* Defective cylinder mounting.</b>			
Observation:			
a. Loose or unsecured mounting.	EA		
*** {Severity L}			
b. Broken or missing mounting.	EA		
*** {Severity H}			

## 07.07 MEDICAL GAS SYSTEMS

### COMPONENTS (Continued)

#### ♦ 07.07.02 GAS DISTRIBUTION NETWORK

The gas distribution network delivers medical gases from the storage units to the terminal connectors. The valves, located in flush mounted cabinets at the head of each zone or wing, control the gas supply for that area. The connectors are non-interchangeable. It is important that all pipes, valves and connectors be labeled and color coded.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* <b>Defective piping and fittings.</b>			
Observation:			
a. Bent or crushed pipe.	EA		
*** {Severity H}			
* <b>Defective supports or hangers.</b>			
Observation:			
a. Loose supports or hangers.	EA		
*** {Severity L}			
b. Broken or missing supports or hangers.	EA		
*** {Severity H}			
* <b>Defective connectors.</b>			
Observation:			
a. Dusty or dirty.	EA		
*** {Severity H}			
* <b>Defective valve handle.</b>			
Observation:			
a. Bent handle.	EA		
*** {Severity L}			
b. Damaged or missing handle.	EA		
*** {Severity H}			
* <b>Control cabinet defects.</b>			
Observation:			
a. Door sprung, defective latch.	EA		
*** {Severity F}			
b. Missing or cracked plexiglass.	SF		
*** {Severity F}			

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**07.07 MEDICAL GAS SYSTEMS**

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**COMPONENTS (Continued)**

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**◆ 07.07.02 GAS DISTRIBUTION NETWORK (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Corroded supports or hangers.</b>			
Observation:			
a. Surface corrosion no pitting evident.	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	SF		
*** {Severity H}			
<b>* Defective labeling.</b>			
Observation:			
a. Damaged or missing labels.	EA		
*** {Severity H}			
b. Damaged or missing color coding.	LF		
*** {Severity H}			



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**07.07 MEDICAL GAS SYSTEMS**

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**COMPONENTS (Continued)**

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**♦ 07.07.03           ALARMS**

There are several alarms built into the distribution system that alert the control group. There is a "reserve-in-use" switch-over alarm that is activated when any backup medical gas supply goes into operation, a "pressure" alarm and a "low level" alarm. These devices are tied into the control system.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Defective electrical connections.</b>			
Observation:			
a.   Loose or frayed wiring.	EA		
*** {Severity H}			
b.   Disconnected.	EA		
*** {Severity F}			
<b>* Defective activators/sensors.</b>			
Observation:			
a.   Loose sensors.	EA		
*** {Severity M}			
b.   Missing or damaged sensors.	EA		
*** {Severity H}			

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**07.07 MEDICAL GAS SYSTEMS**

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**REFERENCES**

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1. American Society for Hospital Engineering of the American Hospital Association, 1990
2. Scientific Enterprises, 1985

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**07.07 MEDICAL GAS SYSTEMS**

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<b>LEVEL II KEY</b>	<b>GUIDE SHEET CONTROL NUMBER</b>
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N/A

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<b>LEVEL III KEY</b>	<b>GUIDE SHEET CONTROL NUMBER</b>
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N/A

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## **07.08 ACID WASTE COLLECTION SYSTEMS**

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### **DESCRIPTION**

Acid Waste Collection System is a subsystem of the Building Plumbing System. The Acid Waste Collection System provides for the collection and neutralization of acid waste products.

### **SPECIAL TOOL AND EQUIPMENT REQUIREMENTS**

No special tools are needed for the inspection of the Acid Waste Collection System, beyond the requirements listed in the Standard Tools Section.

### **SPECIAL SAFETY REQUIREMENTS**

The following special safety requirements, beyond those listed in the Master Safety Plan and System Safety Section, are necessary to perform the inspection of the Acid Waste Collection System.

1. The inspector should exercise extreme caution when inspecting the Acid Waste Collection System due to the potential health hazards associated with the various and unknown concentrations of the waste acids.

### **COMPONENT LIST**

- ◆ 07.08.01 INTERCEPTORS
- ◆ 07.08.02 PIPING AND FITTINGS
- ◆ 07.08.03 ACID HOLDING/NEUTRALIZATION TANKS

### **RELATED SUBSYSTEMS**

Due to the related nature of the elements requiring inspection, the following subsystem should be reviewed for concurrent inspection activities.

07.03 SANITARY COLLECTION SYSTEMS

## 07.08 ACID WASTE COLLECTION SYSTEMS

### STANDARD INSPECTION PROCEDURE

This subsystem requires a Level I inspection as part of the basic inspection process. Associated defects and observations for each major component, are listed in the Field CAIS.

The Facility Manager will authorize any Level III inspection he feels necessary for specialized pump and motor applications.

### COMPONENTS

#### ◆ 07.08.01 INTERCEPTORS

An interceptor is provided to collect acids for disposal through a drain system.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Leaking interceptor.			
Observation:			
a. Loose access panel bolts.	EA		
*** {Severity M}			
b. Missing access panel bolts.	EA		
*** {Severity H}			
c. Missing/damaged access panel.	EA		
*** {Severity H}			
* Corrosion.			
Observation:			
a. Surface corrosion (no pitting evident).	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	SF		
*** {Severity H}			

## 07.08 ACID WASTE COLLECTION SYSTEMS

### COMPONENTS (Continued)

#### ♦ 07.08.02 PIPING AND FITTINGS

Piping and fittings provide the distribution network for the acid waste collection system.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Leaking/damaged fitting.</b>			
Observation:			
a. Bent or cracked fitting, not leaking.	EA		
*** {Severity M}			
b. Waste acid leaking.	EA		
*** {Severity H}			
<b>* Leaking/damaged pipe.</b>			
Observation:			
a. Bent or cracked pipe, not leaking.	LF		
*** {Severity M}			
b. Waste acid leaking.	LF		
*** {Severity H}			
<b>* Loose/missing supports/hangers.</b>			
Observation:			
a. Loose supports or hangers.	EA		
*** {Severity L}			
b. Broken or missing supports or hangers.	EA		
*** {Severity H}			
<b>* Corrosion of hangers or supports.</b>			
Observation:			
a. Surface corrosion (no pitting evident).	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			
<b>* Defective pipe labeling/color coding.</b>			
Observation:			
a. Damaged or missing labels	EA		
*** {Severity L}			

## 07.08 ACID WASTE COLLECTION SYSTEMS

### COMPONENTS (Continued)

#### ◆ 07.08.03 ACID HOLDING/NEUTRALIZATION TANKS

Acid holding tanks store the used acid where it is neutralized for safe disposal.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<b>* Leakage.</b>			
Observation:			
a. Leaking from tank or tank fitting.	EA		
*** {Severity H}			
<b>* Physical tank damage.</b>			
Observation:			
a. Abrasions.	SF		
*** {Severity M}			
b. Impact damage, dents.	SF		
*** {Severity M}			
c. Cracked tank.	SF		
*** {Severity H}			
<b>* Control system failure.</b>			
Observation:			
a. Damaged/disconnected PH meter.	EA		
*** {Severity H}			
b. Damaged/disconnected PH metering pumps.	EA		
*** {Severity H}			
c. Damaged/disconnected mixing motors.	EA		

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**07.08 ACID WASTE COLLECTION SYSTEMS**

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**REFERENCE**

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1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988
2. NAVFAC MO-322, Vol. II Inspection for Maintenance of Public Works & Public Utilities, 1993
3. American Water Works Association, Manual of Water Supply Practices, M-36, 1990
4. NAVFAC P-717.0, Department of Defense, Engineered Performance Standards for Real Property Maintenance Activities
5. Uniform Plumbing Code, International Association of Plumbing and Mechanical Officials, 1979



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**07.08 ACID WASTE COLLECTION SYSTEMS**

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**LEVEL II KEY:            GUIDE SHEET REFERENCE**

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N/A

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**LEVEL III KEY:            GUIDE SHEET REFERENCE**

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1 \*                      GS-III 07.08.02-1 \*

- \* Indicates guide sheets which are not directly referenced by a Key. These Level III Inspection Methods can be implemented, by the Facility Manager, based on an analysis of equipment operating time, equipment age, suspected hidden problems or repeated service calls that indicate a problem exists.

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**LEVEL III INSPECTION METHOD GUIDE SHEET**

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**LEVEL III GUIDE SHEET - KEY NO. 1\***

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**COMPONENT:** PIPING AND FITTINGS**CONTROL NUMBER:** GS-III 07.08.02-1\***Application**

This guide applies to the use of an ultrasonic thickness gauge to determine sediment buildup or detect internal flaws and corrosion of the walls in piping, fittings and valves.

**Special Safety Requirements**

No special safety requirements are needed for the performance of this Level III inspection beyond those listed in the Master Safety Plan and System Safety Section.

**Inspection Actions**

1. Use the ultrasonic thickness testing device to measure the wall thickness of the suspected area.
2. Document the readings and compare to wall thickness of piping in ASTM manual to determine if piping/fittings are defective or damaged.

**Special Tools and Equipment**

1. Ultrasonic Thickness Gauge

**Recommended Inspection Frequency**

This inspection should be performed at the direction of the facility manager on a five year cycle or other periodic basis when the desired degree of reliability justifies the procedure.

**References**

1. EPD Technology Corporation, 12 W. Main Street, Elmsford, New York 10523
2. Means Facilities Maintenance & Repair Cost Data 1993

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**APPENDIX A**

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**ABBREVIATIONS**

<b>AIC</b>	American Institute of Chemists
<b>CAIS</b>	Condition Assessment Information Survey
<b>CAS</b>	Condition Assessment Survey
<b>CERL</b>	Construction Engineering Research Laboratory
<b>DCD</b>	Data Collection Device
<b>DIA</b>	Diameter
<b>EA</b>	Each
<b>FT</b>	Foot
<b>GS</b>	Guide Sheet
<b>HRS</b>	Hours
<b>ID</b>	Interior Diameter

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**APPENDIX A**

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<b>IPS</b>	Iron Pipe Size
<b>IU</b>	Inspection Unit
<b>LF</b>	Linear Foot
<b>N/A</b>	Not Applicable
<b>NAVFAC- MO</b>	Naval Facilities Maintenance and Operations
<b>NDT</b>	Non-Destructive Testing
<b>PE</b>	Professional Engineer
<b>PM</b>	Preventative Maintenance
<b>RPIL</b>	Real Property Inventory List
<b>RPM</b>	Revolution Per Minute
<b>SAE</b>	Society of Automotive Engineers
<b>SF</b>	Square Foot

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**APPENDIX A**

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<b>TM</b>	Technical Manual
<b>UOM</b>	Unit Of Measure
<b>YRS</b>	Years
<b>WBS</b>	Work Breakdown Structure
<b>°</b>	Degrees of Temperature
<b>°C</b>	Degrees Centigrade
<b>°F</b>	Degrees Farhenheit
<b>=</b>	Equals
<b>'</b>	Feet
<b>&gt;</b>	Greater Than
<b>≥</b>	Greater Than or Equal To
<b>"</b>	Inches

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**APPENDIX A**

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$<$	Less Than
$\leq$	Less Than or Equal To
$/$	Per or Over
$\%$	Percent
$+$	Plus or Positive or Add
$\pm$	Plus or Minus
$-$	Subtract or Minus or Negative
$\cdot$	Times or By
$\times$	Times or By

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**APPENDIX B**

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**GLOSSARY**

Aerator	A device which introduces air into an exiting stream of water.
Ambient	Surrounding; on all sides.
Ammeter	An instrument for measuring the strength of an electric current (rate of flow) in terms of amperes.
Arching	The band of sparks or incandescent light formed when an electric discharge is conducted from one electrode or conducting surface to another; characterized by relatively high current and low potential difference between electrodes.
Backflow Preventers	A device used to keep water (or liquids) from being siphoned into a potable water system.
Base Metal	The metal to be welded, soldered, or plated.
Bells (housing)	A hollow metal cylinder closed at one end and flared at the other; used to protect the operator and internal parts and to contain lubrication. A conical device that seals the top of a blast furnace or other mechanical device.
Bowl	A deep rounded container, open at the top.
Bubble Test	An inexpensive test used on domestic water fittings or other low pressure, low temperature systems. Designed to detect leaks before a system comes into use; a solution of detergent and water is brushed on the test fitting while under air pressure, any bubbles noted are signs of an improper seal on the fitting.
Ceramic	A product made by the firing or baking of a nonmetallic mineral, such as tile, cement, plaster refractors and brick.
Commutator	That part of a direct-current motor or generator which serves the dual function, in combination with brushes, of providing an electrical connection between the rotating armature winding and the stationary terminals, and of permitting reversal of the current in the armature windings.
Concrete Cracks	Hairline cracks are defined as shallow cracks that are the width of a human hair, normally occur in a random pattern and result in no loss of surface. Medium and larger cracks can be larger than a hairline size and normally follow a pattern and result in surface loss.

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## APPENDIX B

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**APPENDIX B**

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Conduit	A tube or pipe used to protect electric wiring. A tube or pipe used for conveying fluid.
Corrosion	The deterioration of metal or of concrete by chemical or electrochemical reaction resulting from exposure to weathering, moisture, or chemicals, or other agents in the environment in which it is placed.
Desiccant	A substance having a great affinity for water and used as a drying agent.
Dielectric	A nonconductor of electricity; an insulator or insulating material.
Dielectric (unions)	A pipe fitting that is used to connect the ends of two pipes, neither of which can be turned; it consists of three pieces, the two end pieces (having inner threads), which are tightened around the pipe ends to be joined, and a center piece, which draws the two end pieces together as it is rotated, effecting a seal. It is made of material which contains an electrical insulator; which is used to prevent a electrolytic reaction and thus prevent corrosion.
Differential Pressure Gauge	Apparatus to measure pressure differences between two points in a system; it can be a pressured liquid column balanced by a pressured liquid reserrmed metallic pressure elemeopposing force, or an electrical-electronic gage (such as strain, thermal-conductivity, or ionization).
Drain	A channel or pipe for carrying off water, sewage, etc. to draw off water or liquid so as to dry or empty the drained area.
Erosion	The deterioration brought about by the abrasive action of fluids or solids in motion.
Fatigue	The tendency of a metal or other material to crack and fail under repeated applications of stress.
Faucet	A device with a hand-operated valve for regulating the flow of a liquid from a pipe, barrel, etc.; a cock or tap.
Fixture	Any of the fittings and furniture of a house, store, etc. attached to the building and, ordinarily, considered legally a part of it. An electrical device which is secured to a wall or ceiling and used to hold lamps. A receptacle which receives and discharges water, liquid, or waterborne wastes into a drainage system with which it is connected.

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## APPENDIX B

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**APPENDIX B**

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Flue Duct	An incombustible and heat-resistant enclosed passage in a chimney to control and carry away products of combustion from a fireplace, furnace, or boiler to the outside air.
Galvanic Action	An electrochemical action which takes place when dissimilar metals are in contact in the presence of an electrolyte, resulting in corrosion.
Gaskets	A continuous strip of resilient material attached to a panel or frame to provide a tight seal between the frame and the panel. Any ring of resilient material used as a joint to prevent leakage.
Gauge	A standard measure or scale of measurement, dimensions, capacity, thickness. Any device for measuring something as the thickness of wire, the dimensions of a machined part, the amount of liquid in a container, steam pressure, etc.
Grade	The ground elevation or level, contemplated or existing, at the outside edge of a building, or elsewhere at the building site. Or the slope of a line of pipe with reference to the horizontal.
Grate	A framework of parallel or latticed bars set in a window, door, floor, etc.; design to keep out unwanted items but let air, light, and water, through.
Hermetic	Completely sealed by fusion, soldering, etc. so as to keep air or gas from getting in or out; airtight.
Housing	A hollow metal cylinder closed at one end and flared at the other; used to protect the operator and internal parts and to contain lubrication. A conical device that seals the top of a blast furnace or other mechanical device.
Impellers	The rotating member of a fan, turbine, blower, axial or centrifugal pump, or mixing apparatus. Also known as a rotor.
Infrared Temperature Tester	An instrument that focuses and detects the infrared radiation (heat energy) emitted by an object in order to determine its temperature.
Insulation	A material providing high resistance to heat flow; usually made of mineral wool, cork, asbestos, foam glass, foamed plastic, diatomaceous earth, etc. fabricated in the form of batts, blankets, blocks, boards, granular fill and loose fill.

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**APPENDIX B**

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Leach	To cause a liquid to filter down through some material. To lose soluble matter as a result of the filtering through of water. To dissolve and be washed away.
Level	A horizontal line or plane; especially such a plane taken as a basis for the measure of elevation.
Life Cycle	Under normal conditions, the expected life span based on proper installation and preventive maintenance.
Plumb	Exactly vertical.
Potable	Fit to drink; something drinkable.
Porcelain	A glazed or unglazed vitreous ceramic whiteware used for electrical, chemical, mechanical, structural, or thermal components.
Pulleys	A wheel having a grooved rim for carrying a rope or other line and turning in a frame.
Reciprocating/Scroll	Moving alternately back and forth; interchange position.
Rotor	The rotating member of an electrical machine or device such as the rotating armature of a motor or generator or the rotating plates of a variable capacitor.
Sediment	The matter which settles to the bottom of a water (or any other liquid) vessel.
Seep	To leak, drip, or flow out slowly through small openings or pores, ooze. A place where water, oil, etc. oozes out of the ground to form a pool.
Sewage Ejectors	A pumping device used to lift sewage to a higher elevation.
Sheaves	An assembly consisting of a pulley wheel, side plates, shaft, and bearings over which a rope or cable is passed; a pulley sheave.
Shower Head	A device (usually a nozzle having many fine openings) through which water is sprayed.

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**APPENDIX B**

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Siphon	A bent tube used to carry liquid out over the edge of a container through the force of atmospheric pressure upon the surface of a liquid; one end of the tube is placed in the liquid; the other, the longer end, outside the container at a point below the surface level of the liquid: the tube must be filled, as by suction before flow will start.
Static Pressure	The normal component of stress, the force per unit area, exerted across a surface moving with a fluid, especially across a surface which lies in the direction of fluid flow.
Stator Windings	A fixed part forming the pivot or housing for a revolving part (rotor), as in a motor, dynamo.
Stroboscope	An instrument for making moving objects visible intermittently, either by illuminating the object with brilliant flashes of light or by imposing an intermittent shutter between the light or viewer and the object; a high-speed vibration can be made visible by adjusting the strobe frequency close to the vibration frequency.
Tachometer	An instrument that measures the revolutions per minute or the angular speed of a rotating shaft.
Test Cocks	A valve through which the performance of a product is measured under various conditions.
Ultrasonic Thickness Gauge	A thickness gauge in which the time of travel of an ultrasonic (frequencies just above the range of human hearing) beam through a sheet of material is used as a measure of the thickness of the material.
Valve	A device which regulates or controls the flow of a liquid or gas.
Voltmeter	An instrument for measuring the voltage drop between any two points in an electric circuit.

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**APPENDIX C**

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**LIFE CYCLES****07 BUILDING PLUMBING****07.01 PLUMBING FIXTURES**

Plumbing Fixtures 20 Years

Source:

Means Facilities Maintenance Standards, 1988, Roger W. Liska, PE, AIC, 1988

**07.02 DOMESTIC WATER DISTRIBUTION SYSTEMS**

Piping, Fittings and Valves	
Copper	30 Years
Steel	20 Years
Plastic	20 Years
Pumps	15 Years
Hot Water Heaters	15 Years
Heat Exchangers	24 Years
Backflow Preventers	15 Years

Source:

Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

**07.03 SANITARY COLLECTION SYSTEMS**

Piping, Fittings and Valves	
Copper	30 Years
Steel	20 Years
Cast Iron	35 Years
Plastic	20 Years
Sump Pump Systems	15 Years
Grease Traps	20 Years
Oil and Gasoline Interceptors	20 Years

Source:

Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

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**APPENDIX C**

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**07.04 STORM WATER COLLECTION SYSTEMS**

Piping, Fittings and Valves	
Copper	30 Years
Steel	20 Years
Cast Iron	35 Years
Plastic	20 Years
Sump Pump Systems	15 Years
Dry Wells	25 Years

## Source:

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988
2. Constructing & Maintaining Your Well & Septic System, Max and Charlotte Alth, 1984, TAB Books Inc

**07.05 COMPRESSED AIR SYSTEMS**

Air Compressors	15 Years
Motors	18 Years
Storage Tanks	30 Years
Dryers and Filters	15 Years
Piping, Fittings and Valves	
Copper	30 Years
Steel	20 Years
Controls	17 Years

## Source:

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988
2. Means Estimating Handbook, R.S.Means Company, Inc., 1990

**07.06 VACUUM SYSTEMS - CLINIC/LABORATORY/SHOP**

Vacuum Pumps	15 Years
Motors	15 Years
Holding Tanks	30 Years
Piping, Fittings and Valves	
Copper	30 Years
Steel	20 Years
Controls	15 Years

## Source:

Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

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**APPENDIX C**

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**07.07 MEDICAL GAS SYSTEMS**

Storage Cylinders	10 Years
Storage Tanks	25 Years
Tubing	30 Years
Valves	20 Years
Connectors	10 Years

**Source:**

Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

**07.08 ACID WASTE COLLECTION SYSTEMS**

Interceptors	20 Years
Piping And Fittings	30 Years
Acid Holding/Neutralization Tanks:	20 Years

**Source:**

Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988